

**EFFECTS OF TWO REFLECTIVE TEACHING STRATEGIES ON
SECONDARY SCHOOL TEACHERS' CLASSROOM PRACTICES AND
STUDENTS' ACHIEVEMENT IN BIOLOGY IN IBADAN**

BY

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ABSTRACT

The teaching of biology has always been beset by routine and inadequate classroom practices and poor students' achievement. Most of the methods adopted in teaching the subject did not bring about improved teachers' classroom practices even where they affected students' performance. This is partly because of the inability of biology teachers to carry out reflective teaching which involves continuously examining and evaluating their classroom practices. Reflective teaching strategies have been found to have the potential to improve teachers' professional practice. Previous studies on biology teaching and learning in Nigeria have concentrated more on instructional methods used by teachers than on the use of instructional process to improve students' achievements. This study, therefore, determined the effect of Reflective Focus Group Discussion - RFGD and Reflective Peer Observation - RPO strategies on teachers' classroom practices and students' achievement in biology. It also considered the moderating effects of teachers' reflective teaching knowledge and gender.

The study adopted a pretest-posttest, control group, quasi-experimental design using a 3x2x2 factorial matrix. Eighteen Senior School II biology teachers and intact classes of 576 students in all were drawn from nine selected secondary schools in Ibadan metropolis. The schools were randomly assigned to experimental and control groups. The two experimental groups were exposed to RFGD and RPO strategies respectively while the control group was exposed to conventional method. The treatment lasted for eight weeks. Instruments used were: Teachers' Instructional Guide for RFGD strategy ($r = 0.82$), Teachers' Instructional Guide for RPO strategy ($r=0.80$), Teachers' Classroom Practice Observation Scale ($r = 0.80$), Teachers Instructional Guide for Conventional Method ($r = 0.85$), Instructional Guide for Facilitator ($r = 0.72$), Instructional Guide for Observers ($r = 0.70$), Reflective Teaching Knowledge Test ($r = 0.85$) and Students' Achievement Test in Biology ($r = 0.86$). Seven hypotheses were tested at the 0.05 level of significance. Data were analysed using descriptive statistics, Analysis of Covariance (ANCOVA) and Scheffe post hoc test.

Treatment had significant effects on teachers' classroom practices ($F_{(2,17)}=148.3$; $\eta^2=0.81$) and students' achievement ($F_{(2,563)}=218.5$; $\eta^2=0.49$). Teachers in the RFGD group had highest classroom practices score ($\bar{x}=83.7$) followed by RPO ($\bar{x}=76.9$) while the control had the least ($\bar{x}=31.3$). Students of teachers in the RFGD group had the highest achievement mean score ($\bar{x}=14.8$) followed by those in RPO group ($\bar{x}=12.2$) and control group ($\bar{x}=9.3$). Teachers' reflective teaching knowledge and gender had no significant effect on teachers' classroom practices and students' achievement. Interaction effect of treatment and teachers' gender was significant on students' achievement ($F_{(2,563)} = 5.4$; $\eta^2=0.12$) with RFGD being more effective for both genders while others were not significant on teachers' classroom practices and students' achievement. Interaction effects of treatment, teachers' gender and reflective knowledge was not significant on teachers' classroom practices and students' achievement.

Reflective focus group discussion followed by reflective peer observation strategies improved teachers' classroom practices and students' achievement in biology. Therefore, the two strategies should be used by biology teachers for improved classroom practices.

Keywords: Reflective teaching, Teachers' classroom practice, Achievement in biology, Secondary school students in Ibadan.

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November, 2014

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CERTIFICATION

I certify that this research work was carried out by Adedamola Aderoju KAREEM, in the Department of Teacher Education, Faculty of Education, University of Ibadan, Nigeria.

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DEDICATION

This work is dedicated to the Almighty God, the giver of life, the omnipotent, the omniscient and the omnipresent for being my alpha and omega from the beginning and to the end of this programme. Glory be unto His name. Halleluyah.

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TABLE OF CONTENT

Title page	i
Abstract	ii
Acknowledgements	iii
Certification	vi
Dedication	vii
Table of Contents	viii
List of Tables	x
List of Figures	xi
List of Plates	xii
List of Abbreviations	xiii
List of Appendices	xv
CHAPTER ONE	
INTRODUCTION	1
1.1 Background to the study	1
1.2 Statement of the problem	12
1.3 Research questions	13
1.4 Hypotheses	13
1.5 Scope of the study	14
1.6 Significance of the study	14
1.7 Definition of terms	15
CHAPTER TWO	
LITERATURE REVIEW	17
2.1 Theoretical framework	18
2.1.1 Social constructivist theory	18

2.1.2	Formal and implicit metacognitive theory	19
2.1.3	Theory of experiential learning	21
2.2	Conceptual framework	24
2.2.1	Teacher Preparation for biology instruction	27
2.2.2	Classroom practice and biology teachers	30
2.2.3	Classroom practice and reflective teaching	34
2.2.4	Strategies for reflective teaching	38
2.2.4.1	Reflective Focus Group Discussion Strategy	40
2.2.4.2	Reflective Peer Observation strategy	41
2.3	Empirical Review	42
2.3.1	Reflective focus group discussion strategy and teachers' classroom practices	42
2.3.2	Reflective peer observation strategy and teachers' classroom practices	44
2.3.3	Reflective focus group discussion strategy and students' achievement in Biology	46
2.3.4	Reflective peer observation strategy and students' achievement in Biology	48
2.3.5	Teachers' reflective teaching knowledge and classroom practice	50
2.3.6	Teachers' reflective teaching knowledge and students' achievement in Biology	52
2.3.7	Teachers' gender and its influence on teachers' classroom practices	52
2.3.8	Teachers' gender and its influence on students' achievement in Biology	53
2.4	Appraisal of literature	54

CHAPTER THREE

METHODOLOGY

3.1	Research design	57
3.2	Variables in the study	58
3.3	Selection of Participants	58
3.4	Choice of teaching content	59

3.5	Research instruments	59
3.5.1	Teachers' Instructional Guide for Reflective Focus Group Discussion strategy (TIGRFD)	59
3.5.2	Validity and reliability of TIGRFGD	60
3.5.3	Teachers' Instructional guide for Reflective Peer Observation strategy (TIGRPO)	60
3.5.4	Validity and reliability of TIGRPO	59
3.5.5	Teachers' Instructional Guide for Conventional Method (TIGCM)	62
3.5.6	Validity and reliability TIGCM	62
3.5.7	Teachers' Classroom Practice Observational Scale (TCPOS)	62
3.5.8	Validity and reliability of TCPOS	63
3.5.9	Instructional guide for Facilitators (IGF)	63
3.5.10	Validity and reliability of IGF	64
3.5.11	Instructional Guide for Observers (IGO)	64
3.5.12	Validity and reliability of IGO	64
3.5.13	Biology Teachers' Reflective Teaching Knowledge Test (BTRKT)	65
3.5.14	Validity and reliability of BTRKT	65
3.5.15	Students' Achievement Test in Biology (SATB)	65
3.5.16	Reliability and validation of SATB	66
3.6	Procedure for data collection	66
3.7	Procedure for training of observers	69
3.8	Procedure for training of teachers	70
3.9	Data analysis	74
CHAPTER FOUR		
RESULTS		75
4.1	Answer to research questions	75
4.2	Testing of hypotheses	79
4.3	Summary of findings	90
CHAPTER FIVE		
DISCUSSION, CONCLUSION AND RECOMMENDATIONS		92

5.1	Discussion	92
5.1.1	Effects of Treatment on Teachers' Classroom Practices and Students' Achievement in Biology	92
5.1.2	Effects of Teacher's Reflective Teaching Knowledge on Teachers' Classroom Practices and Students' Achievements in Biology	97
5.1.3	Effect of Teachers' Gender on Teachers' Classroom Practices and Students' Achievement	99
5.1.4	Interaction Effect of Treatment and Teachers' Gender on Teachers' Classroom Practices and Students' Achievement in Biology	100
5.1.5	Interaction Effect of Teachers' Reflective Teaching Knowledge and Gender on Classroom Practices and Students' Achievement	101
5.2	Conclusion	102
5.3	Implication of findings	102
5.4	Recommendations	103
	REFERENCES	105
	APPENDICES	122

LIST OF TABLES

Table	Title	Page
1.1	Statistics of Enrolment and Results in May/June Senior Secondary Certificate Examinations in Biology in Nigeria. (2001-2013)	6
3.1	3x2x2 factorial matrix	55
3.2	Table of Item Specification	63
3.3	The Time Frame for the Study	66
4.1	Descriptive Statistics of Pre and Post treatment of Biology Teachers' Classroom Practices by Treatment groups, Teachers' Knowledge and Teachers' Gender.	72
4.2	Descriptive Statistics of Pre and Post treatment Achievement Scores of Students in Biology by Treatment Groups, Teachers' Knowledge and Teachers' Gender	74
4.3	Mean Scores of Pre, Mid and Post treatment Observation Scores of Biology Teachers Classroom Practices	75
4.4	Summary of ANCOVA of Post-treatment Teachers' Classroom Practice by Treatment, Knowledge and Gender	77
4.5	Multiple Classification Analysis (MCA) of Post-treatment Classroom Practices by Treatment Knowledge and Gender	78
4.6	Scheffe Post hoc Tests of Teachers' Classroom Practices by Treatment	79
4.7	Summary of ANCOVA of Posttreatment Students' Achievement Scores by Treatment, Teachers' Knowledge and Teachers' Gender	81
4.8	Multiple Classification Analysis (MCA) of Students' Achievement in Biology by Treatment, Teachers' Knowledge and Teachers' Gender	82
4.9	Scheffe Post hoc Tests of Students' Achievement by Treatment	83

LIST OF FIGURES

Figure	Title	Page
Figure 2.1	Experiential Learning Cycle	22
Figure 2.2	Diagrammatic Representation of the conceptual framework of Reflective Teaching	25
Figure 4.1	Differences between the pre, mid and post treatment observation of biology teachers' classroom practice in the two treatment and control groups	76
Figure 4.2	Adjusted Posttreatment Classroom Practice for Biology Teachers Across Reflective Strategies	79
Figure 4.3	Relative Effectiveness of the Treatment Groups on Students' Achievement in Biology	83
Figure 4.4	Interraction Effect of Treatment and Teachers' Gender on Students' Achievement in Biology	86

LIST OF PLATES

Plate	Title	Page
Plate 1:	The researcher training the participants for reflective focus group discussion strategy	157
Plate 2:	The researcher training a reflective peer observation strategy Group	158
Plate 3:	The researcher demonstrating scoring of classroom practice observation with a video recorded classroom teaching of a teacher to observers during their training	159
Plate 4:	The researcher interacting with the facilitators and instrument during training	160
Plate 5:	A reflective focus group discussion strategy during reflective Activities	161
Plate 6:	A reflective peer observation strategy group with an observer during reflective activities	162
Plate 7:	An observer observing a teacher in classroom during Teaching	163
Plate 8:	Students of Holy Trinity Grammar School, Ibadan during administration of Achievement test (SATB)	164
Plate 9:	Students of Eleyele High School, Ibadan during administration of achievement Test (SATB)	165

LIST OF ABBREVIATIONS

AC	Abstract Conceptualization
AE	Active Experimentation.
ANCOVA	Analysis of Covariance.
BTRTKT	Biology Teachers' Reflective Teaching Knowledge Test.
CE	Concrete Experience.
FGN	Federal Republic of Nigeria.
IGF	Instructional Guide for Facilitators
IGO	Instructional Guide for Observers.
MCA	Multiple Classification Analysis.
MKO	More Knowledgeable Other.
NABT	National Association of Biology Teachers.
NCE	Nigeria Certificate of Education.
NECO	National Examinations Council.
NUT	National Union of Teachers.
PGDE	Post Graduate Diploma in Education.
POSTOBS	Post Observation.
PREOBS	Pre Observation.
RFGD	Reflective Focus Group Discussion.
RO	Reflective Observation.
RPO	Reflective Peer Observation.
SATB	Students' Achievement Test in Biology.
SS II	Senior Secondary School Two.
SSCE	Senior School Certificate Examinations.
STAN	Science Teachers Association of Nigeria.
TCPOS	Teacher's Classroom Practice Observation Scale.
TIGCM	Teachers' Instructional Guide for Conventional Method.

TIGRFGD	Teachers' Instructional Guide for Reflective Focus Group Discussion Strategy
TIGRPO	Teachers' Instructional Guide for Reflective Peer Observation Strategy.
WAEC	West African Examinations Council.
ZPD	Zone of Proximal Development.

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LIST OF APPENDICES

Appendix	Description	Page
I	Teachers' Instructional Guide for Reflective Focus Group Discussion Strategy (TIGRFGD)	122
II	Teachers' Instructional Strategy for Reflective Peer Observation Strategy (TIGRPO)	126
III	Teachers' Instructional Guide for Conventional Method (TIGCM)	130
IV	Instructional Guide for Facilitators (IGF)	131
V	Instructional Guide for Observers (IGO)	132
VI	Teachers' Classroom Practice Observational Scale (TCPOS)	133
VII	Procedure for Training Observers	140
VIII	Procedure for Training Facilitators	142
IX	Biology Teachers' Reflective Teaching Knowledge Test (BTRTKT)	144
X	Students' Achievement Test in Biology (SATB)	148
XI	An example of Reflective Activities on a given Topic (Skeleton and Supporting Tissues in Animals)	153
XII	Lesson Note for Sampled Teachers in Experimental Group 1	156
XIII	Lesson Note for Sampled Teachers in Experimental Group 2	157
XIV	Lesson Note for Sampled Teachers in Control Group	158
XV	Selected Topics Under Ecology Taught by the Teachers for the Study	159

CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Biology is the study of life. It deals with the study of varieties of living organisms. It is one of the science subjects studied at the senior secondary school level in Nigeria. The study of the subject provides students with an understanding of the structure and functions of living organisms (man inclusive) and the relationship between these organisms and their immediate environment. It also enables the learners to acquire the attributes needed for the resolution of diverse human problems in and out of school.

The aims and objectives of secondary school biology as stated in the National Policy of Education, FRN (2004; 2013) further highlight its merits:

1. To develop an awareness of the environment;
2. To have meaningful and relevant knowledge in biology necessary for successful living in a scientific and technological world;
3. To make room for technological advancement;
4. To inculcate the habit of critical observation and drawing conclusions only from available data;
5. To illuminate the problems of sex, reproduction, growth, pollution, health etc for the benefit of the society;
6. To disperse superstitious beliefs in a technological method.

In view of the above, biology is looked upon as a subject which provides solution to most human activities and problems. According to the West African Examinations Council Syllabus (WAEC, 2003; 2009; 2013) and the National Examinations Council Syllabus (NECO, 2010), acquisition of biological knowledge gives the learners adequate ability to apply biological principles to everyday life in matters that are personal, environmental, economic and which relate to community and community health. Therefore, biology which is the most popular science subject among senior secondary school students in Nigeria (Okoye, 2006; Baram-Tsabari et al, 2009; Onwuachu & Nwakonobi, 2009) is expected to be effectively taught in schools by well trained and

experienced teachers in order to achieve the objectives of teaching the subject at secondary school level.

Unfortunately, in spite of the importance of teachers in the teaching and learning of biology, studies have revealed some inadequacies in the classroom practices of some teachers. Some of these inadequacies include poor communication of teachers as shown in their inability to properly communicate biological concepts to students to effect learning (Imhanlahimi & Aguele, 2006; Akinfe et al, 2012), poor utilization of instructional materials for teaching (Ehikhamenor, 2003; Olagunju, 2005; Oriade, 2008), inadequate assessment of students during teaching to assess the extent to which students have learnt (Winne, 2007; Bawa, 2011) and poor management of allocated time for teaching (Botson, 2002; Olaleye, 2011).

Effective communication is an important aspect of classroom practice in schools. The communication style of a teacher is a key factor in teaching and in helping students to learn. Potyrala et al (2011) referred to communication as one of the basic professional skills of biology teachers through which information is transmitted from teacher to learners. However, it has been observed that it could be a problem for students' learning especially when teachers use unfamiliar words (Akinsola, 2005) or fail to provide challenging learning environment (Busari, 1993) through their choice of words. Most biology teachers have been reported to lack adequate ability to communicate the subject matter to students during teaching. The choice of language by most biology teachers in the process of communicating biological concepts has been described as inappropriate during teaching in classroom. This according to Wabuke et al (2013) has accounted for biology teachers' reliance upon textbooks and notes. In such cases, the teachers are unable to deliver the concepts and contents in a way that can be understood by the learners due to the teachers' failure to use personal words in communicating contents. Ibe and Maduabum (2011) in support of this observation acknowledge that biology teachers' verbal communication is often poor, confusing, and end up providing mixed information to students. Akiri and Ugborugbo (2009) and Wabuke et al (2013) note that the problem of language barrier and lack of good verbal expression lead to poor pronunciation of difficult words and verbatim reading from textbooks among biology teachers. All the

foregoing result in the failure of such teachers to produce desired results in students during the course of classroom teaching.

However, when communication is supported with instructional materials, teaching is better facilitated, clearer, interesting and results in more effective students' learning (Adeyanju, 2003; Anulobi, 2009). Instructional materials according to Doubleglist (2013) have been defined as all tools which could be used in the classroom systems that the teacher employs to make learning more conceptual, concrete, factual and illustrative without which the learner can forget what has been taught. Such materials in biology teaching include real objects, visual aids such as charts, pictures, audio-visual aids such as television, videotape, etc.

Instructional materials have been found to reinforce verbal information, thus enhancing the effectiveness of instructions by moving content from abstract to concrete. Akinfe et al (2012) acknowledge that the use of instructional materials in the teaching-learning process is less stressful for both teacher and students. But many studies have shown that instructional materials are not available or adequately utilised in teaching biology. Onyegegbu (2001) and Ofili (2003) report non-availability of instructional materials for teaching biology in some schools. Where the instructional materials are available, Wabuke et al (2013) report poor qualities and quantities of the materials. Some biology teachers have also been noted by Umaru (2011) to neglect the use of instructional materials in much of their teachings, thus teaching in abstract. This implies that whatever is the current situation of instructional materials in such schools, the biology teachers avoid the use of these materials in teaching. In support of this, Ehikhamenor (2003) and Oriade (2008) showed that the non-utilisation of instructional materials by biology teachers due to lack of appropriate skills in their use. It follows that because of the non-use of instructional materials, teachers may struggle in teaching of abstract concepts which the students would have understood better if they were made to interact with concrete materials. Therefore, the relevance of instructional materials in ensuring the effective communication of difficult/abstract concept to students cannot be ignored.

The use of poor questioning technique during teaching among biology teachers have been revealed by several studies. Olakulehin (2007) and Iliya (2011) observe that

teachers lack an effective questioning style which would engage students in higher order thinking skills. The biology teachers were observed to frequently ask low level cognitive questions which require students to recall information easily from what was taught as opposed to carrying out mental manipulation of information. This may affect students' performance in WAEC examinations which are set on high level cognitive questions. Ajaja (2009) identifies the non inclusion of both low-level and high-level cognitive questions which cover all domains of learning in students' assessment as a common practice by biology teachers. This problem may stem from teachers inadequate command of English Language and poor choice of words in communicating contents during teaching. Moreover, where teachers do not employ effective time management strategies in their classrooms, they may carry on teaching until the lesson time runs out without making provision for adequate time for teacher's questioning on content taught during the teaching and learning process. This may cause them to fall back on the use of low level questions or avoid questions totally.

Poor management of lesson time for teaching has been revealed as another inadequate classroom practice among biology teachers (Ajaja, 2009; Olaleye, 2011 and Potyrala, et al 2011). Many biology teachers have been observed to have failed in sharing lesson time equitably for various activities that take place during teaching. Such teachers teach without planned time frame for each of the expected activities. They may have prior planning for the activities expected to take place during teaching, but failed to specify time frame for each of the activities. In such situation, the teachers end up mismanaging the lesson time for teaching. In support of this view, Olaleye (2011), Gbore and Daramola (2013) report that biology teachers' do not use instructional time effectively. However, the poor use of instructional time may lead to inability of such teacher to cover the syllabus. Ajaja (2009) acknowledges that poor management of time among teachers leads to non-coverage of the content of the subject matter. Such non-coverage of the content may lead to students' inability to answer questions set on such topics left untaught by the teacher which may eventually lead to poor performance of the students in the subject in examinations.

The reasons for the inadequacies observed among biology teachers in classroom practices may be due to inability of teachers to continuously use, practice and finetune all the necessary classroom teaching skills they have acquired during teacher training. Therefore, there may be need for re-training of biology teachers to continuously assess these classroom teaching skills qualitatively and quantitatively. Teachers are the most influential agents in the teaching and learning process and play key roles in curriculum implementation and are among important players influencing and impacting students' learning. The quality of a teacher's teaching determines to a large extent the students' level of understanding. Udeani and Adeyemo (2011) remark that studies have shown that teacher's quality is the most important educational input predicting students' achievement. Teachers could be referred to as the most important players influencing students' achievement as they hold the key to determine students' learning outcomes. This implies that the level of students' achievement in a subject depends mainly on the input of the teachers during teaching. According to Alausa (2007) and Akiri and Ugborugbo (2009), both teaching and learning depend on teachers and these have important influence on students' academic achievement. Adodo (2007) also refers to teachers as one key factor for the success of students' learning. Therefore, the inadequacies in teachers' classroom practices are likely to have an influence on students' achievement since teachers according to Olakulehin (2007), Ayodele (2009) and Akbari and Allvar (2010) tend to produce students after their own kind. This implies that effective teachers produce high performing students while ineffective teachers produce students of lower academic ability. This may be the case with biology students in the secondary schools in Nigeria as evident in students' poor achievement in biology inspite of the importance of the subject.

This is shown in the performance of students in biology at the Senior School Certificate Examination (SSCE) as revealed in Table 1.1.

Table 1.1: Statistics of Enrolment and Results in May/June Senior School Certificate Examinations in Biology in Nigeria. (2001-2013)

Year	Entry for Biology (No of Candidates)	Credit 1- 6 (% of Candidates)	Pass 7- 8 (% of Candidates)	Fail F9 (% of Candidates)
2001	995345	23.25	29.70	47.04
2002	882119	31.52	30.64	37.82
2003	1005553	42.22	26.95	26.47
2004	1005894	29.68	32.41	34.68
2005	1051557	35.74	29.84	32.18
2006	1137181	49.23	25.70	22.96
2007	1238163	33.37	32.09	32.47
2008	1259965	33.94	26.18	38.41
2009	1340206	28.59	30.82	32.17
2010	1325408	49.65	24.49	22.86
2011	1532865	38.25	30.52	29.77
2012	1687024	35.66	28.25	33.77
2013	1678154	51.66	26.86	20.96

Source: Test Administration Department, West African Examinations Council (WAEC) National Office, Yaba, Lagos. (June 30, 2014)

Table 1.1 shows that students' performance in biology is not encouraging as the highest percentage at credit and above level was 51.66%, those with ordinary pass level was 32.41%. Though, this is above average (i.e above 50%), the percentage is not encouraging enough since the percentage is not high. Apart from year 2013, which is the only year having candidates with credit and above more than 50% pass, the percentage pass at credit level and above consistently falls below 50% in all the years. Even the year that recorded the highest number of candidates who entered for the examination had a very low percentage (35.66%) of candidates with credit pass and above. A critical look at table 1.1 during the period under review further shows that the trend in students' performance in biology has not changed over the years with greater percentage of students scoring below credit grade.

The poor performance of students in biology has been attributed to their performance in concepts like ecology (Ige, 1998; Esiobu, 2000; Tekkaya et al, 2001). This poor performance in ecology is stressed by WAEC (2002; 2006; 2007; 2010) in which the Chief Examiners' Reports indicated that candidates showed poor grasp of the concepts of ecology and that a lot of candidates fail to attempt questions raised on

ecology concepts and those who attempted the questions showed low coverage and poor understanding of the concept and thus performed badly. Furthermore, WAEC (2009; 2010; 2011) Chief Examiners report that students show poor performance in questions on ecology. The ecological concepts found difficult are environment, habitat, and population studies. Among these concepts, habitat featured most in the years reviewed.

Other reason identified for poor performance of students in biology pointed to routine and monotonous teaching of several biology teachers (Ibe & Maduabum, 2001; Ofoegbu, 2004; Ajaja, 2009; Udeani & Adeyemo, 2011; Akinfe et al, 2012). The studies reveal that several biology teachers have been teaching biology concepts in the same manner thus, teaching becomes monotonous in nature. Such manner of teaching is likely to promote memorization of facts by students since the teacher fails to consider and analyse the nature of teaching being carried out in the classroom. This implies that such teachers have failed to appraise and approach their teaching activities with dynamism. In order for teachers to move beyond routine response to classroom teaching and approach lessons with dynamism, some authors have suggested the need for observation and reflection on teaching to bring about changes by teachers getting involved in reflective teaching (Ferraro, 2000; Richards, 2000; Ogonor & Badmus, 2006; 2010; Ajitoni, 2008; Onwuachu & Nwaknobi, 2009; Menon & Alamelu, 2011). Stressing the importance of reflective teaching in bringing dynamism to teaching, Richards (2000) and Ferraro (2000) acknowledge that reflective teaching is an approach that moves teachers beyond the level of routine responses to classroom situations to achieve a higher level of awareness of how teaching is done and the consequences of particular instructional decisions. Furthermore, Ogonor and Badmus (2006: 2010), Ajitoni (2008) suggest that teachers need to think about what is done in classroom, how and why it is done, as a way of bringing about changes, thus improving their teaching through reflection.

Reflective teaching involves deliberate systematic appraisal, continuous examination and assessment of classroom processes. This is a professional development practice in which teachers critically and systematically analyse their own practice and its underlying basis and consider alternative means of achieving their ends. The focus is on how teachers think about their work and what they think about. Reflective teaching involves turning a subject and action over in one's mind and giving it serious and

systematic consideration. According to Richards and Lockhart (1994) and Ajitoni (2008) reflective teaching is a practice in teaching whereby teachers collect data about teaching, examine their attitudes and beliefs, assumptions and teaching practices and use the information obtained as a basis for critical assessment of their teaching for the purpose of improvement. The practice of reflective teaching is observed to be made up of certain integral steps such as collection of descriptive data which involves gathering information about classroom events, analysis of data collected in terms of attitudes, assumptions, goals and consequences revealed, consideration of how the situation or activity could have been different and creation of a plan that incorporates new things. This implies that a teacher is able to think critically about one's teaching assumptions and choices of teaching styles when involved in reflective teaching. Thus, such a teacher does not only know what is being done about teaching, but also why they are doing it and what will happen as a result of doing it.

Reflective teaching could be carried out using different strategies. These strategies as identified by scholars include focus group discussion (Taggart & Wilson, 2005; Farrell, 2009; Menon & Alamelu, 2011), peer observation (Hall, 1997; Pollard, 2005; Menon & Alamelu, 2011), 'critical friend' (Hall, 1997; Larrivee & Cooper, 2006), diary keeping/ journal writing (Hall, 1997; Pacheco, 2005; Farrell, 2009; Menon & Alamelu, 2011), 'story-sharing or telling' (Hall, 1997; Bailey, 1997; Larrivee & Cooper, 2006), 'lesson recording' (Pacheco, 2005, Rezaeyan & Nikoopour, 2013), 'self report' (Richards, 1992; Taggart & Wilson, 2005), mentoring (Hall, 1997), students' feedback (Pacheco, 2005; Tice, 2004; Menon & Alamelu, 2011), brainstorming (Taggart & Wilson, 2005; Minott, 2009), action research (Kailin, 1997; Bassoff, 2004; Larrivee & Cooper, 2006).

Several studies have been carried out on reflective teaching using pre-service teachers. These have concentrated on strategies using journal writing/diary keeping (Sessum, 2007), 'story sharing or telling' (Gimenez, 1999), 'self report' (Ferraro, 2000), students' feedback (Amobi, 2005), 'lesson recording' (Amobi, 2005), and mentoring (Ogonor & Badmus, 2006). However, few studies have been carried out using in-service teachers (Ferraro, 2000; Florez, 2001; Tice, 2004; Pacheco, 2005; Ajitoni, 2008; Farrell, 2007; 2009; 2010). Most of these studies on in-service teachers concentrated on English

language with Ferraro (2000) using storytelling and self report strategies, Posteguillo and Palmer (2000) and Florez (2001) used journal writing/diary keeping while Bassoff (2004) applied action research and Pacheco (2005) used video recording and diary keeping strategies. Studies on other subjects among in-service teachers are Physics (Chung et al, 1995) using mentoring and Computer Science (Kilpatrick et al, 1995) using lesson recording. However, not many reports have been recorded in literature as to the extent to which other strategies such as reflective focus group discussion and reflective peer observation strategies would influence teachers' practices as well as students' achievement especially in a subject like biology. This study therefore focused on the use of reflective focus group discussion and reflective peer observation strategies.

Reflective focus group discussion strategy involves a group of teachers meeting together to reflect in order to compliment each other's strength and compensate each other's limitations (Taggart & Wilson 2005; Farrell, 2007). The group convenes regularly for meetings to systematically consider, analyse and evaluate their teaching beliefs, attitudes, assumptions and practices. A facilitator who is the leader and coordinator of the group is usually provided. The group will engage in critical consideration, analysis and evaluation of classroom events and make decisions for improving classroom situations before and after teaching. The group meets to reflect before the teacher goes to the classroom to teach and then re-convenes after teaching for reflective discussion. In second meeting which is after the class, the teachers' teaching actions are compared with the decisions which the group took during reflection before teaching. The conclusion reached during this reflective discussion by the group will enable the teachers concerned to make necessary corrections in the next teaching cycle.

Reflective peer observation is a strategy which involves colleagues pairing up for reflection (Tice, 2004; Taggart and Wilson, 2005). Two teachers are involved in reflective activities before and after teaching. The teachers would work in pairs and take turns to observe each other's classes during teaching. Prior to each observation, the two teachers would meet to discuss the nature of the classes to be observed and after observation, the two teachers would meet again to systematically analyse and evaluate data collected in each partner's classroom and how these can be used to bring about improvement in the next teaching.

Important as reflective teaching is to teaching and teachers, Gimenez (1999), Gugapersad (2008) and Minott (2009) report that it has not received due enthusiastic response from teachers. Supporting this view, Ajitoni (2008) remarks that teachers continue to exhibit automatic or routine responses to classroom situations and therefore advocates that they are made to move to a higher level of awareness of how to teach, and the value and consequences of particular instructional decisions through reflective teaching. All these imply that teachers may not be involved in the practice of reflective teaching. The failure of teachers to practice reflective teaching may be due to two factors. One of the factors is that many lecturers (teacher educators) do not approach their teaching with reflection and so cannot model reflective teaching for their students (Amobi, 2005; Gugapersad, 2008). The second factor is that the teachers while in training were not exposed to the knowledge and practice of reflective teaching. Therefore, if teacher educators do not practice reflective teaching and there is no provision in the curriculum for it to be taught to pre-service teachers, it becomes impossible for in-service teachers to have the knowledge of the practice of reflective teaching.

The study of Gottschalk- Mazouz (2008) describes knowledge as the confident understanding of a subject with the ability to use it for a specific purpose. Therefore, knowledge is a detailed familiarity or understanding of a situation (Gottschalk-Mazouz, 2008). Knowledge could also mean the state or the act of knowing. Many teachers lack the knowledge of reflective teaching due to their inability to acquire such knowledge while in school, since it is not in the teacher training curriculum or being modeled by their lecturers. This corroborates Mann (2005) assertion that it is the application of theoretical knowledge of reflective teaching that can have professional influence on teachers. Therefore, if teachers possess the knowledge of the process of reflective teaching which involves considering, analysing and assessing their teaching actions, they could have a better understanding of how these processes can have impact on their management of instruction and the students learning and performance. Meanwhile the lack of the knowledge of reflective teaching may result in absence of application of professional knowledge that is so important in being an effective teacher.

In considering teachers' application of knowledge in classroom practice, Drudy and Chathan (2002) argue that teachers' knowledge acquisition and application in the

classroom are influenced by gender. This means that the quality and quantity of knowledge acquired by teachers and application of such knowledge in classroom practice depend on gender. On the other hand, Elstad and Turmon (2005) claim that there is no gender difference in teachers' quality of knowledge acquisition and application in classroom. This means that teachers acquire knowledge for classroom practice in the same manner irrespective of their gender. However, other studies have found that, acquisition of knowledge by teachers during training while in school may or may not depend on teacher's gender. If teachers, irrespective of gender possess knowledge of the process of reflective teaching, which involves considering, analysing and assessing teaching actions, there could be better understanding of how this process may have impact on teachers' management of instruction and the students' learning and achievement.

Very few of the available research works on reflective teaching (Amobi, 2005; Ogonor and Badmus, 2006; David et al, 2010) have been on pre-service teachers. The study of Ogonor and Badmus (2006) on pre-service teachers' reflectivity in a Nigerian University reveals that the pre-service teachers who had been exposed to reflective teaching exuded confidence and had improved teaching practice rating however they observed a lack of support from the supervising teachers of the respective cooperating schools used for the teaching practice. The in-service teachers could not give adequate support on reflective teaching to pre-service teachers due to their lack of understanding or knowledge of the process.

Amobi (2005) describes reflective teaching as having the potentials of helping pre-service teachers in self correction with respect to specific elements in their emerging teaching skills. However, the study revealed that in-service teachers need to master the process of reflectivity in teaching and be able to adequately support and encourage reflection of teachers on practice teaching and so as to make the process to be more effective for such teachers who are still in training. Kiely and Davis, (2010) also found that reflective teaching helped pre-service teachers gain insight into constructing lesson plans to enhance their teaching skills. These and other studies (Amobi, 2005; David et al, 2010; Ogonor & Badmus, 2010; Oguntuberu, 2012) report an improvement on the teaching skills of pre-service teachers when exposed to reflective teaching during

teaching practice, but expressed the opinion that for the practice to be effective in improving teachers, in-service teachers need to inculcate the practice of reflective teaching. Therefore, this study determined the effects of exposing in-service biology teachers' to two reflective teaching strategies on teachers' classroom practices and students' achievement in biology.

1.2. Statement of the Problem

Efforts in teachers' professional development have been concentrated on acquisition of pedagogical skills to be used in classroom practice so as to enhance students' learning and achievement. However, over the years, teachers have often applied these acquired skills repeatedly in a routine manner. Biology teachers have consistently executed the skills acquired during training in the same and monotonous manner without their consideration on how well these skills are applied each time in the classroom. They do not systematically consider and evaluate the way skills in communication, use of instructional materials, questioning, classroom management of time for instruction are executed in the class in terms of how appropriate and effective their choices may be. This may be the reason why students' achievement has also been found to be consistently poor in SSCE. The biology teachers lack the ability to appraise and reappraise what they do in the classroom and consider how it affects students' performance since this is not incorporated into teacher education curricula. In the light of the fact that teacher's activities in the classroom are vital in helping students learn concepts such as ecology in biology, the situation therefore calls for an intervention to appraise and reappraise teachers' practice in the classroom in order to concentrate on the use of instructional process, as this may influence students' performance and teachers' classroom practice in the subject. It is against this background that this study determined the effect of two reflective teaching strategies on teachers' classroom practices and students' achievement in biology. This study also determined the moderating effects of teachers' gender and teachers' knowledge of reflective teaching on teachers' classroom practice and students' achievement.

1.3. Research Questions

The study attempted to answer the following research questions:

1. What are the pre and post treatment classroom practice scores of teachers' based on:
 - (a) Treatment Groups- reflective focus group discussion, reflective peer observation and conventional.
 - (b) Level of teachers' reflective teaching knowledge; and
 - (c) Teachers' Gender.
2. What are the pre and post treatment achievement scores of students in biology based on:
 - (a) Treatment Groups- reflective focus group discussion and reflective peer observation and conventional.
 - (b) Level of teachers' reflective teaching knowledge; and
 - (c) Teachers' Gender?
3. What are the pre, mid and post treatment classroom practice scores of biology teachers?

1.4 Hypotheses

The study tested the following null hypotheses at 0.05 alpha level of significance:

- (1) There is no significant main effect of treatment on:
 - (a) Teachers' classroom practices.
 - (b) Students' achievement in biology.
- (2) There is no significant main effect of teachers' reflective teaching knowledge on:
 - (a) Teachers' classroom practices.
 - (b) Students' achievement in biology.
- (3) There is no significant main effect of teachers' gender on:
 - (a) Teachers' classroom practices.
 - (b) Students' achievement in biology.
- (4) There is no significant interaction effect of treatment and teachers' reflective teaching knowledge on:
 - (a) Teachers' classroom practices.
 - (b) Students' achievement in biology.

- (5) There is no significant interaction effect of treatment and teachers' gender on:
- (a) Teachers' classroom practices.
 - (b) Students achievement in biology.
- (6) There is no significant interaction effect of teachers' reflective teaching knowledge and teachers' gender on:
- (a) Teachers' classroom practices.
 - (b) Students' achievement in biology.
- (7) There is no significant interaction effect of treatment, teachers' reflective teaching knowledge and teachers' gender on:
- (a) Teachers' classroom practices.
 - (b) Students' achievement in biology.

1.5 Scope of the Study

The study covered five hundred and seventy six senior secondary school two (SSII) biology students and eighteen teachers from nine coeducational schools in three Local Government Areas (Ibadan North, Ibadan North East and Ibadan North West) within Ibadan metropolis of Oyo State. The main topic taught is ecology. The topic was selected based on biology teachers' indication of difficulty in teaching the topic and WAEC Chief Examiners' Reports of the unpopular nature of answering questions on ecology by students and poor performance among few students who attempted such questions. The concepts taught under this topic based on the curriculum prescription as contained in the senior secondary two syllabus are (i) terrestrial habitat, (ii) aquatic habitat and (iii) estuarine habitat. The study attempted to determine the effect of two reflective teaching strategies - reflective focus group discussion and reflective peer observation strategies on teachers' classroom practices and students' achievement in biology. Teachers' reflective teaching knowledge and gender were the moderating variables considered.

1.6 Significance of the Study

Findings from this study would encourage biology teachers to practice reflective teaching especially through focus group discussion and peer observation strategies, thereby, spurring biology teachers to get actively involved in continuous improvement of classroom teaching and students' achievement.

The information from this study would also enable biology teachers to teach conveniently, concepts such as ecology and any other topic presumed to be difficult to teach. It is also expected that from this study, biology students would be able to answer and perform very well in questions on ecology.

The result would also encourage promotion of reflective practice among teachers in schools by heads of schools. The information provided from the study would reveal the need for organization of seminars and workshops on reflective teaching for in-service teachers by the government.

A further significance of the study is that its result would expose the need for inclusion of reflective practice into the curriculum of teacher preparation at Nigeria Colleges of Education (NCE) and Faculties of Education in order to assist students in acquiring knowledge of reflective practice while in training. The findings from this study, could serve as an eye opener for teacher educators to be reflective practitioners in order to serve as role models to their students.

1.7. Definition of Terms

The following terms are operationally defined as used in the study:

Facilitator: This is one of the teachers in the focus group discussion strategy who serves as the leader and coordinator of the group. He/she coordinates the reflective discussions and leads the group to conclude at each item of reflection.

Reflective Focus Group Discussion: This is a type of reflective teaching strategy which involves regular discussions among a group of science teachers with systematic critical consideration, analysis and evaluation of classroom practices of biology teachers.

Reflective Peer Observation: This is a type of reflective teaching strategy in which only two biology teachers engage in systematic critical consideration, analysis and evaluation of their classroom practices.

Reflective Teaching: This is a practice in which teachers carry out systematic critical consideration, analysis and evaluation of teaching assumptions and attitudes in classroom practice.

Reflective Teaching Knowledge: This is the detailed understanding of the concept and the practice of reflective teaching by secondary school biology teachers (as measured with Biology Teachers' Reflective Teaching Knowledge Test).

Students' Achievement Test in Biology: This is students' achievement as measured by the grades obtained on a test set on ecology concepts in biology.

Teachers' Classroom Practices: These are all activities that teachers carry out in the classroom in the teaching and learning process. In this study, it is restricted to communication style, use of instructional materials, questioning style and time management. (as measured by the Teachers' Classroom Practice Observation Scale).

CHAPTER TWO

LITERATURE REVIEW

Literature for this study was reviewed under the following headings:

- 2.1 Theoretical framework
- 2.2 Conceptual Framework.
 - 2.2.1 Teacher Preparation for Biology Instruction
 - 2.2.2 Classroom Practice and Biology Teachers
 - 2.2.3 Classroom Practice and Reflective Teaching
 - 2.2.4 Strategies of Reflective Teaching
- 2.3 Empirical Framework.
 - 2.3.1 Reflective Focus Group Discussion Strategy and Teachers' Classroom Practice.
 - 2.3.2 Reflective Peer Observation Strategy and Teachers' Classroom Practice.
 - 2.3.3 Reflective Focus Group Discussion Strategy and Students' Achievement in Biology.
 - 2.3.4 Reflective Peer Observation Strategy and Students' Achievement in Biology.
 - 2.3.5 Teachers' Reflective Teaching Knowledge and Classroom Practice.
 - 2.3.6 Teachers' Reflective Teaching Knowledge and Students' Achievement in Biology.
 - 2.3.7 Teachers' Gender and its Influence on Teachers' Classroom Practice.
 - 2.3.8 Teachers' Gender and its Influence on Students' Achievement in Biology.
- 2.4 Appraisal of Literature Reviewed.

2.1. Theoretical Framework

The theories that underpin this study are (i) social constructivist theory (ii) implicit metacognitive theory (iii) theory of experiential learning.

(i) Social Constructivist Theory

The social constructivist theory relevant to this study was propounded by Vygotsky (1978). The theory asserts three major themes: (i) social interaction plays a fundamental role in the process of cognitive development. Vygotsky felt social learning precedes development. He states that every function in the learner's cultural development appears twice: first, on the social level between people (interpsychological), and later on the individual level inside the learner (intrapsychological) and (ii) The More Knowledgeable Other (MKO). This refers to anyone who has a better understanding or a higher ability level than the learner. In this case the MKO could be peers, coach, a younger person, older adult or even a computer. (iii) The Zone of Proximal Development (ZPD) which is the distance between a learner's ability to perform a task under adult guidance and/or with peer collaboration and the learner's ability to perform independently.

The theory emphasizes education for social transformation and posits human development that situates the individual within a socio-cultural context. It focussed on connections between people and the sociocultural context in which they act and shared experiences. Individual development is said to be derived from social interactions within which cultural meanings are shared by a group and eventually internalized by an individual. According to the theory, construction of knowledge by individuals is done in transaction with the environment, and in the process both the individual and the environment are changed. It argues further that individuals make meaning through their interactions with each other and with the environment. Hence, meaningful learning and shaping of individual behaviour occur when individuals are engaged in social activities. Vygotsky highlighted the convergence of the social and practical elements in learning with most significant moment of intellectual development occurring when speech and practical activities converge. Social constructivist views learning as an active process

during which learners should learn to discover principles, concepts and facts for themselves that the responsibility for learning should reside increasingly with the learner, hence emphasizing the importance of active involvement of the learner in the learning process. This encourages uses of facilitators whose critical role is to help learners get the understanding of the content and also become effective thinkers. In social constructivist, the facilitator and the learner are equally involved in learning from each other.

Social constructivist theory by Vygotsky is relevant to reflective teaching in making teachers learners. Such teachers can make meaningful knowledge about their classroom practices through interactions with each other and the environment. During these interactions, teachers construct and generate knowledge through questions about classroom experiences and by critical thinking on those experiences. Knowledge is also created and constructed through convergence of social and practical elements in learning by teachers. This creates a dynamic interaction between facilitator and other teachers since both are equally involved in learning from each other. During the process of reflection among teachers, awareness of each other's view points and personal beliefs, standards and values about classroom practice are developed; thus being subjective and objective at the same time. As teachers work together and support each other with a variety of information resources in their pursuit of learning goals, and solving classroom problem in teaching, classroom practice and learning environment take a decided orientation. Central to the theory is the idea that learning is an active process of trying to make sense out of new experience. As teachers share and are involved in collaborative interaction and reflection on experiences, learning is enhanced through discourse and the creation of opportunities to explain one's understandings while also having opportunity to understand the perspective of another individual hence facilitate generation of knowledge about classroom experience.

(ii) Formal and Implicit Metacognitive Theory

The theory was propounded by Flavell (1976) and it posits a highly systematised level of thinking which involves cognitive awareness or knowledge of one's and other's thinking activities, cognitive process or experience of thinking activities and cognitive regulation or monitoring of the thinking activities expressed in the way of behaviour.

Formal and implicit metacognitive theory explains the knowledge and awareness people have of their own thinking processes and strategies and the ability to evaluate and regulate one's thinking processes through behaviour. The theory consists of high level of thinking of one's cognitive process that involves active control over the process of thinking that is used in learning situations. It is one's knowledge concerning one's own cognitive processes.

The theory is therefore about how people think and explains the ability of an individual to think about what one is doing while experiencing it. Formal and Implicit metacognition is the knowledge and awareness people have of their own thinking processes and strategies and the ability to evaluate and regulate ones thinking processes. It is learning to think about the 'how' and 'why' of what one does. It is conscious awareness of an individual's thinking process. Schoenfeld (1987) remarked that metacognitive knowledge involves knowledge about cognition and awareness about one's cognition.

Formal and Implicit metacognitive theory is relevant to reflective teaching because it involves a teacher's conscious awareness of his or her thinking process. This theory which involves thinking processes or strategies and the ability to evaluate and regulate one's thinking processes is in line with the practical approach in reflective teaching. Formal and implicit metacognitive theory is applied when teachers critically think and reflect on classroom practice and learn from such experiences during reflection. While practicing reflective teaching, teachers create cognitive awareness of their classroom experience, regulate and learn from the experience through critical thinking. Therefore, reflective teaching involves an application of the three components of formal and implicit metacognitive theory—metacognitive knowledge, metacognitive regulation and metacognitive experience.

The applications of constructivist and metacognitive theories to reflective teaching encourage teachers to consciously create thinking awareness of their classroom practice and learn from it. In the process of sharing and reflection on classroom experiences through discourse with other teachers, knowledge generated is eventually internalized by individual teacher.

The learning which occurs during such reflection may provide problem solving activities and a decided orientation on classroom and teaching of some topics in many school subjects such as ecology in biology. This is especially so in dealing with topics in biology which teachers find difficult and so avoid teaching. Such topics include ecology (habitat), transportation, growth (mitosis).

(iii) Theory of Experiential Learning

This theory was propounded in 1984 by Kolb. It is the most descriptive theory available of the adult learning process (Atherton, 2011). The theory is centred on creation of knowledge through transformation of information from prior experience. It explores the processes associated with making sense of concrete experiences and the learning styles involved in doing so. Experiential learning occurs as a result of learners' participation in events and reflection about the experience. It utilises the participant's own experience and their own reflection about that experience. The theory therefore emphasises critical thinking in planning and creating knowledge which is transformed into concrete experience, which in turn is analysed and evaluated through critical thinking for feedback to be experimented in a new situation. According to Kolb (1984) the theory starts with the premise that people learn best from experience. It is a theory that appears time and again. The theory is modelled out on four stages of activities which are in a continuous cycle. These stages are Concrete Experience (CE), Reflective Observation (RO), Abstract Conceptualization (AC) and Active Experimentation (AE).

Concrete Experience - This involves an individual carrying out a particular action with an effect of such action on a situation. At this stage an individual carries out a definite action and observes the effects of the actions in this situation. The engaged person carry out the actions with intention(s).

Reflective Observation - This involves practitioner stepping back from task involvement and reviewing what has been done and was experienced during task involvement. In such instance, time is taken by such individual to observe and understand the effects of an action, if such action was to be taking again under the same circumstance. This stage concentrates on what the experience means to the participant or practitioner. RO is a

stage which connotes critical analysis and evaluation of observed actions during the experience.

Abstract Conceptualization - This stage involves interpreting the events which have been noticed and understanding the relationship among the events through critical thinking. In this context new understanding would be critically considered, predicted and planned. The stage of AC involves more comprehension and how to draw new ideas from the experience for future experience

Active Experimentation – At this stage, there is application of abstract concepts through action in a new circumstance within the range of generalization. In this context, the new understanding and predictions about what is likely to happen next or actions to be taken to refine the way the task was handled would be translated into actions in the next experience.

Concrete Experience (CE) and Reflective Observation (RO) are essentially the private and personal part of the cycle, while Abstract Conceptualization (AC) and Active Experimentation (AE) are more public and visible to others.

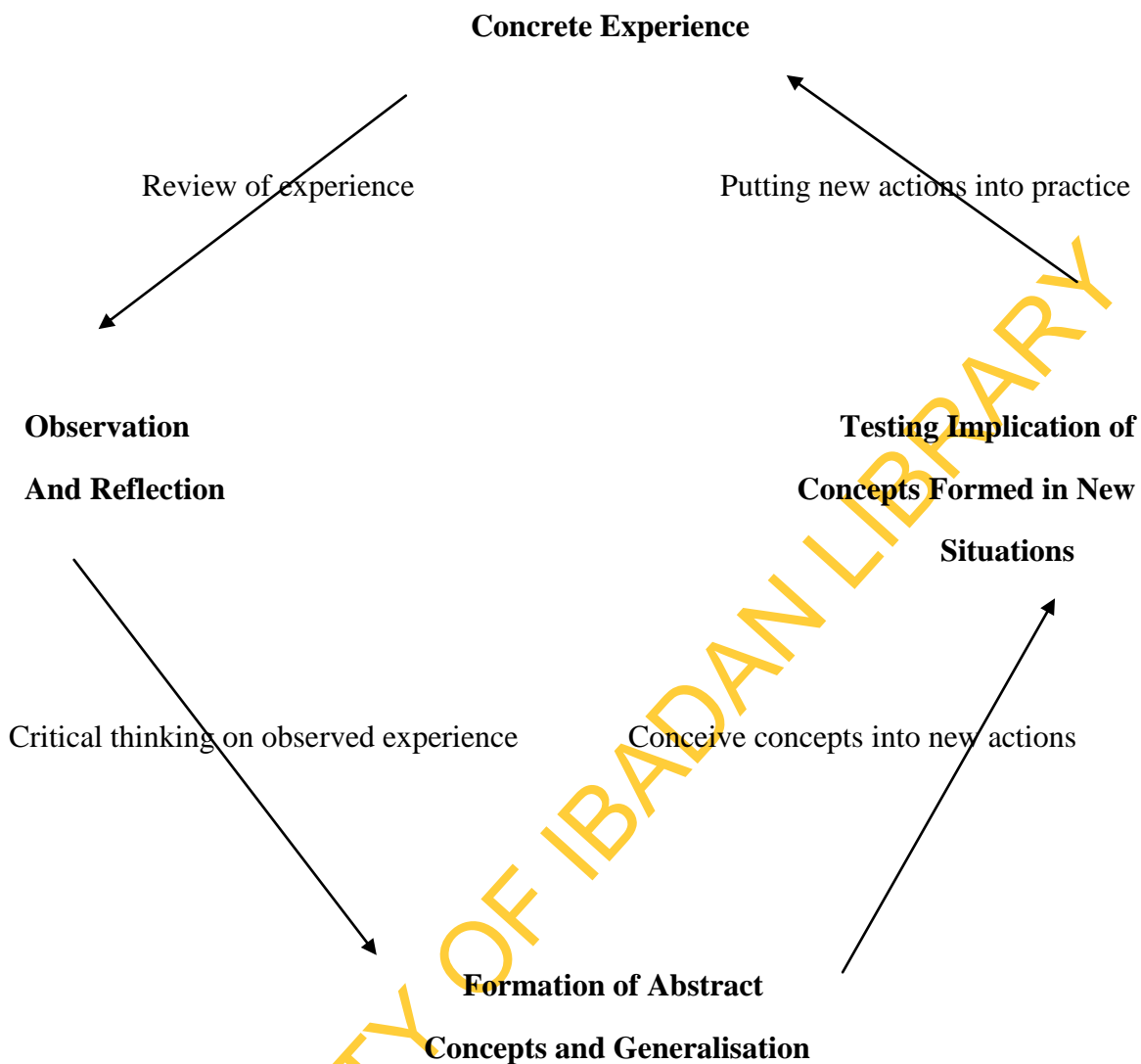


Figure 2.1: Experiential Learning Cycle. (Adapted from Kolb, 1984 and Moon, 2005)

The study draws from this theory in that during reflective teaching, teachers are involved in particular teaching actions with intentions and later step back to observe and review the relationship among the observed events. Thereafter, the teachers plan new understandings and predictions which can be used to refine the way teaching was previously handled through critical thinking. The planned predictions would later be translated to actions in the next teaching in the classroom. The relevance of this theory to the study is also in knowledge being created by biology teachers from observations of previous experience. This is transformed into concrete experience in the classroom and

assessed for better actions in future experience which is continuously applied and reapplied building on prior classroom experience and knowledge.

In the cycle, two aspects can be seen as especially noteworthy: the use of concrete, here-and-now experience to test ideas and the use of feedbacks to change practices and theories.

2.2. Conceptual Framework

The conceptual framework of this study stems from a synthesis between the dimensions of reflective thinking defined by Taggart and Wilson (2005) and the process of reflection as defined by Posteguillo and Palmer (2000) and Pollard (2005). These dimensions consider reflective teaching as a cycle or continuous chain of events which starts with reflection before teaching actions and continues with reflection after teaching actions in the classroom. Reflection before teaching actions involves critical reflection on planning and provision for an experience in order to act and collect data on such action or experience. The steps which are in a sequential mode begin with critical thought on planning the way of approach and process of an experience or event. This is followed with consideration of the provision of materials which would be needed for the planned experience. Thereafter, the activity or event would be carried out as previously planned using the materials provided. Data or information is then collected on the experience or events carried out for later reflection on the action(s).

Reflection on actions after teaching which is continuous from reflection for actions before teaching is a viewed critical reflection through analysis, examination and evaluation of detailed description of the event. As it continues from the last stage of reflection before teaching action, it involves detailed description of what happened during the experience. This is followed by a description of the feelings of an individual teacher about the actions which took place during the event or experience in the classroom. Thereafter, an evaluation of the experience would be done by describing what actions were good or bad with contributions from each teacher. Later, critical analysis about the whole experience of what would have been or was made out of the experience would be done. A conclusion or an agreement on what could have been done to make such actions

better in future experience would be reached. In the next step, such conclusion will act as template for critical reflection for planning actions for future experience. Therefore, a way of approach to subsequent teaching or experience is planned.

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The conceptual framework is represented in the diagram below. A –D represents reflection before teaching while E–J represents reflection after teaching.

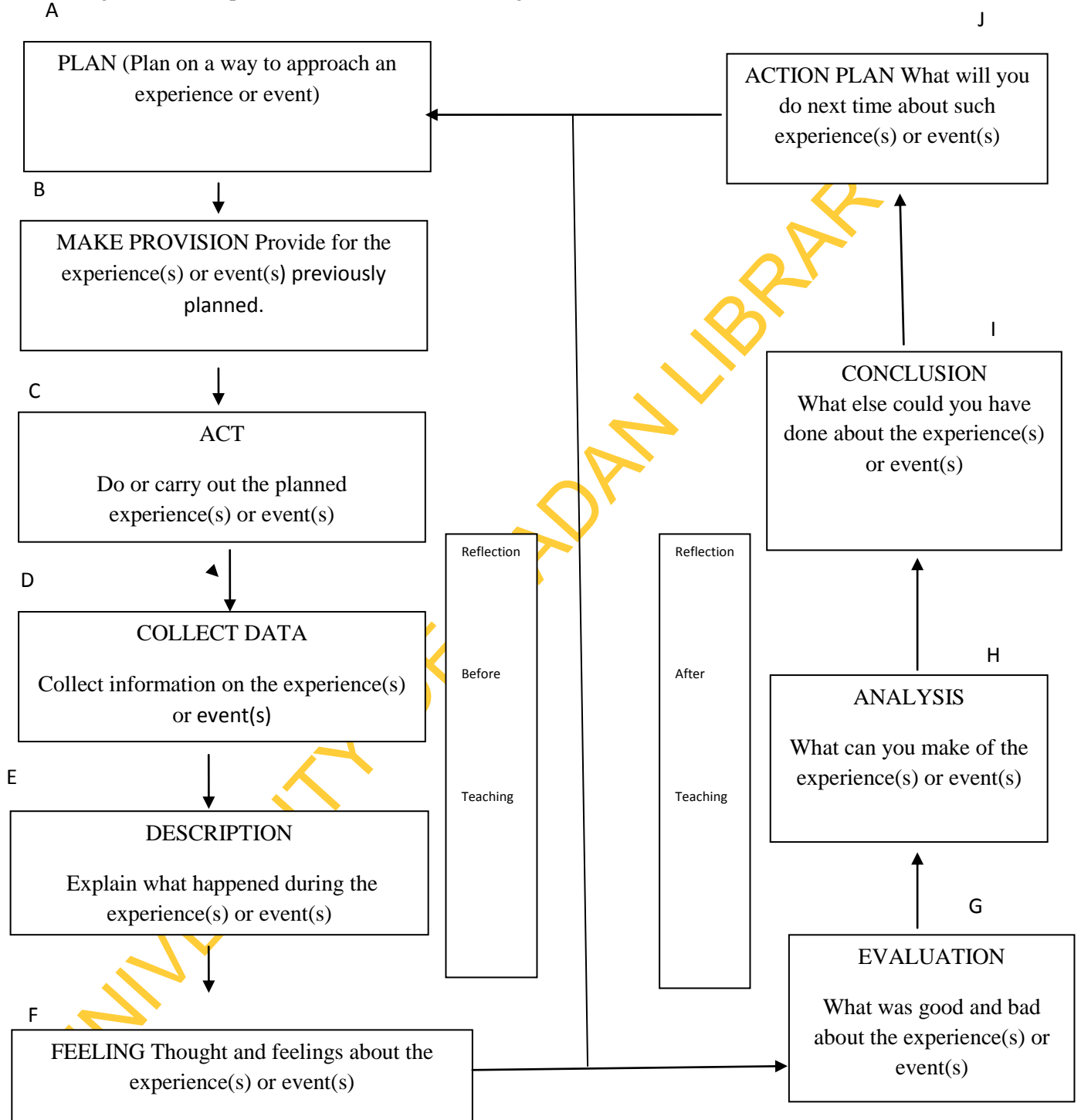


Figure 2.2: Diagrammatic representation of the conceptual framework of Reflective Teaching. (Adapted from Pollard, 2005 and Taggart and Wilson 2005) **KEY:** A-D: Actions in the boxes indicate activities which occurred during reflection before teaching; E-J: Actions in the boxes indicate activities which occurred during reflection after teaching. The arrows indicate the direction or sequence of actions in the process of reflective teaching.

2.2.1 Teacher Preparation for Biology Instruction

Biology is a science subject which deals with the study of varieties of living organisms (man inclusive) and their interaction with the environment. The study of biology provides knowledge and understanding about daily human survival. Akinfe et al (2012) remarked that the study of deadly diseases, their causative agents, finding out cure for hereditary abnormalities like haemophilia, down syndrome etc, control of environmental pollution, experimental breeding of high yielding varieties of crops, and animals, and diseases resistant crops and animals are examples that have made biology of impact in the life of individuals and relevance to a nation. In order to acquire these and other scientific knowledge in biology, teachers are significant facilitators.

Teachers are important factors in acquiring knowledge in teaching and learning process. According to Rice (2003), teachers are important school related factor in learning. They expose learners to knowledge and assist them in the acquisition of such knowledge to improve the quality of human resources. Butressing this view, Akinbote and Okoruwa (2000) remarked that teachers play important role in the teaching and learning process. This implies that teachers are the most influential agents in the provision of education, exposing and assisting learners in the acquisition of such knowledge in a country. Therefore, considering the importance of acquisition of biological knowledge by learners and its impartation by teachers for social relevance in solving social and personal problems in the development of a nation, teachers need to be adequately grounded in necessary qualities for the job especially in classroom practice.

According to the National Association of Biology Teachers (2003), quality preparation of biology teachers before service (i.e pre-service teachers) should include areas of content, pedagogy and assessment. Biology teachers must have a broad preparation of inquiry processes and in content areas. This will enable the teachers to have a profound mastery of the knowledge of the subject. In preparing biology teachers, an essential foundation in content preparation should also include an understanding of the inter-relationship between biology content and other science disciplines. In support of this view, Mallick (2012) claimed that biology teachers must have a working knowledge of other related science subjects such as chemistry, physics, mathematics, geology, etc.

This he claimed will enable biology teachers to handle learners efficiently as science subjects in secondary school curriculum are supplementary to each other in fulfilling the objectives of teaching at a particular stage and application of one subject is easily found in the other. Stressing further, National Association of Biology Teachers (2004) claimed that biology is deeply integrated with other science subjects, therefore, an understanding of the interrelationship between the content of these subjects and biology is essential for a strong foundation in preparation for the teaching of biology in secondary schools.

In pre-service teacher preparation programme for biology teaching, proper pedagogy is required. This involves preparing teachers to have experience with scientific inquiry, establishing a safe and welcoming learning environment, classroom management and application of science technologies in biology. National Association of Biology Teachers (2004) and Mallick (2012) submitted that, it is essential teachers are trained in knowledge of method of teaching and latest techniques or strategies and methodology of teaching biology. This will enable biology teachers to adequately disseminate biological information or knowledge to learners.

Following adequate dissemination of information to learners is assessment of this information in the learners. According to National Association of Biology Teachers (2004), assessment measures learners' ability to generate or clarify questions, construct investigations, formulate conclusions and evaluate the process of science. Assessing or evaluating learners in biology gives the teachers the knowledge of the extent to which biological knowledge has been acquired by such learners. Therefore, it is imperative that pre-service teachers experience how to plan authentic assessment that closely approximates the intended outcomes of biological knowledge.

In addition to the aforementioned qualities in preparing biology teachers, Mellado (2008), Akinfe et al (2012) and Mallick (2012) remarked that biology teachers should be prepared in the following qualities and acquire the necessary skills during training for effective classroom practice after the training. These qualities include good communication of ideas, efficient preparation and use of instructional and teaching aids effective assessment through questioning and qualitative management of available time. Biology teachers are expected to be good communicators of ideas who speak plainly

without ambiguity, clear in speech and able to convey ideas to learners with ease and effectiveness. This will encourage adequate transmission and impartation of biological knowledge in classroom by future biology teachers. In order to facilitate the transmission of biological knowledge, Mellado et al (2007) said that it is important that biology teachers are trained in the ability to communicate with instructional or teaching materials adequately. This involves being able to appropriately and adequately display and use instructional materials for adequate impartation of biological knowledge, attitude and skills in learners. Therefore, biology teachers should be trained in sufficient skills and dexirity in improvisation and construction of his own teaching aids in teaching biology according to the local needs and situations.

In order to utilize instructional materials or aids profitably during teaching, Shalaway (2005) opined that teachers are to possess a good skill in time management. This is equally necessary in preparing biology teachers for future adequate classroom practice since teaching takes time and this is one of the biggest challenges of the profession. In another submission, Mellado (2008) and Cavanaugh (2008) enumerated certain attributes and teaching behaviours biology teachers should possess. These include, the ability to

- 1) have acquired appropriate certification in the subject matter, indicating the possession of deep content knowledge of subject matter.
- 2) plan and provide for appropriate learning experiences for learners.
- 3) communicate and interact with learners
- 4) develop, select and modify instructional plans and materials to meet the needs of all learners
- 5) monitor appropriate use and care of equipment, materials and facilities
- 6) monitor and evaluate learners' outcomes
- 7) strive to maintain and improve professional competence

In addition to the above qualities, Reed (2005) and Mallick (2012) remarked that biology teachers must be trained to possess certain scientific attitudes such as self confidence, patience and good understanding of how to teach without having a rigid technique. It was also acknowledged that, biology teachers must be creative and have the

ability to integrate new ideas which have solid connection to the subject matter, teaching skills and psychological knowledge of learners.

Teacher training preparation in biology should be given adequate attention as against the general belief that anyone who can talk convincingly not minding the level of pedagogy knowledge of such individual can be a teacher. Therefore, in biology teacher preparation programmes, these qualities and scientific attributes should be significant in the curriculum to provide better and continuous future performance on job, which will empower teachers in the teaching of newly introduced or difficult concepts such as ecology (habitat) in future. In teacher preparation programmes for biology teaching, the aforementioned teaching skills in classroom practice should be instilled in the future biology teachers. Their ability to acquire these behaviours will encourage and facilitate appropriate delivery of biological knowledge due to its social relevance to individuals and the country.

2.2.2 Classroom Practice and Biology Teachers

Classroom practice is the activities teachers are involved in during the process of teaching and learning in classroom. Evestson and Weinstein (1999) defined classroom practice as the actions engaged in by teachers during teaching. This infers to the activities the teacher engage in, to produce a conducive learning environment for learners' growth in classroom. It involves the ways the teacher control the students in order to allocate much time to teaching and learning activities. This is also remarked by Kanchak and Eggen (2007) who described classroom practice as consisting of the entire teacher's thought, plan and actions that create an orderly learning environment.

In classroom practice, the teacher creates productive learning environment for effective teaching and learning process. This is also observed in the study of Shauwer (2010) which stated that classroom practice involves all the things a teacher does in order to organize students, space, time and materials so that instruction in content and students' learning can take place effectively in classroom. The study reported further that it consists of practices and procedures that a teacher uses to maintain an environment in which instruction and learning occurs. Such practices and procedures as indicated by McNergney and McNergney (2005), Kauchak and Eggen (2007) and Shauwer (2010)

include communication style, use of instructional materials, teacher's questioning style and time management.

Communication is an important practice in a classroom used to create productive teaching and learning environment. Therefore, to produce qualitative teaching and learning process, communication style of the teacher must be effective. Effective communication which includes verbal and non-verbal has been described by Modebelu and Nwakpedolu (2013) as a teaching skill vital for quality teaching and learning. It affects both the teacher and the students in the process of teaching and learning. Buttressing this submission, Kauchak and Eggen (2007) remarked that communication technique of a teacher fosters active inquiry, collaboration and supportive interaction in the classroom. The way such skill is utilized by a teacher determines how biological information or knowledge is passed or transferred to students in biology classroom. Therefore, a biology teacher requires adequate communication style to create and maintain productive teaching and learning environment in classroom practice.

In classroom, the biology teachers are expected to communicate high standards and expectations to students. The teacher makes learning objectives clear to learners by communicating clearly in writing and in speaking. Madubelu and Nwakpelu (2013) identified five elements of clear communication. These are:

Precise technology: this is elimination of vague and ambiguous words and phrases in teacher's communication with their students.

Connected discourse: it is logical connection in teacher's presentation with one point leading to the other.

Transition Signals: communicate that one idea is ending and another is beginning and the teacher explains the link between the two. This signal allows students to mentally structure the content as the lesson develops.

Emphasis: communicates the special significance an idea or topic has. It helps students determine the relative importance of the topics under learning.

Congruent Verbal and Non-verbal Behaviour: Congruent is how you say what you say while non-verbal is the part of our message that we convey without spoken words. (e.g facial expression, eye contact). For good impact, the verbal must be consistent with non-verbal. An important agent of communication required in such situation in biology classroom is instructional materials.

Instructional materials are materials utilised by teachers to facilitate teaching and learning process. Ugbaja and Egbunonu (2008) referred to instructional materials as aids employed by teachers to enhance the effective instruction. Instructional materials provide integrated experiences which may vary from concrete to abstract in facilitating teaching and learning process. In a supporting view, Adeyanju (2003) remarked that instructional materials are physical and spatial enablers of teaching and learning. The materials promote meaningful teaching and learning in classroom. These materials also have the characteristics of holding the attention of almost all the students in their ability to reinforce verbal messages. Therefore, the utilization of instructional materials by biology teachers during teaching makes learning becomes real and consequently creates an effective stable teaching and learning environment. In communicating content in classroom while teaching, the biology teacher identifies appropriate instructional materials which can promote learning in the classroom and uses these materials adequately. Oriade (2008) stressed that in biology classroom, the use of instructional materials provide integrated result which may vary from the concrete to abstract. Since the use of instructional materials depends on what the teacher makes of them, Oriade (2008) further submitted that effective use of instructional materials in biology teaching would encourage good classroom practice by the teacher.

Effective practice in a biology classroom is promoted through students' assessment during teaching and learning process when the teacher asks questions to stimulate thinking and encourages all students to respond. This encourages students' involvement and facilitates their learning during teaching. In support of this view, Kauchak and Eggen (2007) remarked that teacher's questioning is the most effective and applicable strategy teachers have for promoting students' involvement in classroom practice. Teacher's questioning is particularly an effective way to informally assess

learning in classroom. Since teacher's questioning allows students to describe their understanding during their response, studies (Olson & Clough, 2004; Kauchak & Eggen, 2007) have shown that teacher's question is an indicator of effective organization and clear learning objectives in classroom teaching. Stressing further the importance of teacher's questioning, Pintrich and Schunk (2002) acknowledged that effective questioning engages students and challenges their thinking. Therefore, effective questioning by biology teachers brings about effective classroom practice. In biology classroom, Wabuke et al (2013) submitted that teacher's questioning provides continual feedback about students' learning progress. Questioning by teachers acts as performance evaluation to determine understanding rate of the learning to detect or determine the learners' area of weakness which need to be worked upon or improved.

In order to engage students in effective questioning which would have an impact on students' thinking, biology teachers must follow a particular pattern while asking questions. These according to Bloom's theory include following Bloom's questioning pattern (i.e. recall, comprehension, application, analysis, synthesis and evaluation), questioning frequency (i.e. no of questions asked over a period of time), equitable distribution (a questioning pattern in which all the students equally participated) and time distribution (i.e. given particular time for asking of questions). It is also important that biology teachers understand the types of cognitive question style and the required cognitive process of answering such questions. The two broad cognitive question styles are low level cognitive question style (which requires students to recall materials easily from what they were taught) and high level question style (which requires mental manipulation of information of what students have learnt). In order to assess current understanding, increase students motivation and guides new learning, biology teachers must ensure equitable distribution of questions among students. This according to Kauchak and Eggen (2007) would encourage equal participation of all the students in the classroom and consequently increase in students' curiosity and interest towards learning. A good questioning skill of biology teachers must include time distribution in which the teacher gives particular time for asking and answering of questions.

Time is crucial to teaching and learning in effective classroom practice. Teaching takes time and there is never enough of it. Ability to effectively manage allocated time for a lesson is an important skill required of a teacher. According to Kauchak and Eggen (2007) submission, efficient use of available time is a common feature of effective teachers. Therefore, effective teachers must be able to utilise allocated, instructional, engaged and academic times adequately and appropriately. In biology teaching, teachers need to manage the allocated, instructional, engaged and academic times very well to create an effective teaching and learning process for adequate classroom practice. Time management is the thread running through almost all the aspects of teaching. Therefore, it is crucial for adequate, efficient and effective practice in biology classroom by the teacher.

From the foregoing, it would be observed that classroom practice involving communication style, use of instructional materials, teacher's questioning style and time management is paramount to effective pedagogy and learners' cognitive, achievement and overall development. Therefore, biology teachers need to engage in quantitative and qualitative classroom practice for optimum performance of students in the subject.

2.2.3 Classroom Practice and Reflective Teaching

Classroom practice is activities undertaken by a teacher in the classroom. It involves all activities the teacher engaged in to create a productive learning environment during teaching and learning in classroom. Kauchan and Eggen (2007) remarked that during classroom practice, the teacher attempts to maximise learning and develop in students the ability to manage and direct their own learning. Such procedures and practices involved in the classroom by the teacher to produce effective teaching and learning environment include communication style, use of instructional materials, teacher's questioning pattern and time management.

Communication is fundamental to all teaching. It is the bedrock of all classroom practices in which the life of a teacher revolves round. According to Bot (1998) communication refers to a circular process through which message is transmitted from teacher to learner and vice versa. For efficient and effective communication by teachers

in classroom practice, the use of instructional materials may be important to provide appropriate and adequate representation of concepts. This according to Adeyanju (2003) will facilitate teaching and learning, hence this may promote meaningful classroom practice. Therefore, utilization of instructional materials by teachers prevents abstract teaching in classroom practice, thus creating a stimulated and interesting teaching and learning atmosphere in classroom. Oriade (2008) support this remark and commented that in classroom practice, instructional materials have the characteristics of holding the attention of almost all the students in their ability to reinforce verbal message.

While communicating with or without instructional materials, evaluation of concepts taught by the teacher is paramount. Shalaway (2005) remarked that this is better achieved through questioning the students taught. According to Iliya (2011) questioning is used by teachers to assess students' understanding based on experiences in teaching and learning outcome. Questions usually give direction to learners to examine instructions and according to Wabuke et al (2013) it promotes students' involvement in classroom practice. In such instance, the teacher needs to sequence the questioning mode since appropriate feedback assist to:

- 1) develop interest and motivate students to become actively involved in classroom lesson.
- 2) develop critical thinking skills and inquiring attitudes in students.
- 3) assess achievement of instructional goals and objectives.
- 4) Stimulates students to pursue knowledge on their own.

However, teacher's questioning in classroom practice is expected to be exhibited with the consciousness of instructional time. Effective and adequate management of time is important in classroom practice. Time is regarded as an important string in teaching and learning process. This made Kauchak and Eggen (2007) to conclude that an effective teacher is a good manager of time.

Effective utilization of all the aforementioned practices (communication style, use of instructional materials, teacher's questioning and time management) in classroom may produce teaching effectiveness. In addition, teachers are expected to plan, make

provisions and act (Pollard, 2005) to enhance effective teaching. Therefore, for maintenance of a good classroom practice to create and continuously enhance effective teaching and learning process the teacher need to regularly be dynamic in the application of these skills to maximize learning in classroom. These could be achieved through their involvement in critical thought, consideration, analysis and assessment of their teaching assumptions, beliefs, attitudes and practices for flexibility in the classroom. Such practice is referred to as reflective teaching.

The concept of reflective teaching stems from Dewey's notion of comparison of routine action with reflective action. According to Dewey (1933) in Pollard (2005) routine action is guided by traditional habit, authority, institutional definitions and expectations. By implication, it is relatively static and unresponsive to changing priorities and circumstances. Reflective action on the other hand involves willingness to engage in self-appraisal and development. It implies flexibility, rigorous analysis and social awareness. When reflective action is developed and applied to teaching, it was found to be a challenging and exciting practice, hence referred to as reflective teaching. Campbell-Jones and Campbell-Jones (2002), Pollard (2005) and Taggart and Wilson (2005) have identified the practice of reflective teaching to be characterized by the following:

- 1) active and concerned with aims and consequences.
- 2) applied in a cyclical or spiral process in which teachers monitor, evaluate and revise their own practice continuously.
- 3) requires competence in methods of evidence-based classroom enquiry to support the progressive development of higher standards of teaching.
- 4) requires an attitude of open-mindedness, responsibility and whole heartedness.
- 5) based on teacher's judgement informed by evidence based enquiry.

In addition to the above characteristics, Pacheco (2005) remarked that it involves critical thinking about past, current and future experiences that occurred, are occurring or will occur in classroom settings. Reflective teaching is a practice in which one's action on teaching is subjected to critical thinking, analysis and evaluation. Pacheco (2005) acknowledged that the practice is an attitude which involves stopping, slowing down, noticing, examining, analyzing and inquiring about aspects and complexities encountered

in different teaching situations. Jessy-Bassy (1995) and Ferraro (2000) referred to reflective teaching as an activity or process in which an experience is recalled, considered and evaluated. Reflective teaching is a practice of response to past experience and involves conscious recall and examination of the experience as basis for evaluation and decision making as a source for planning and action.

An array of definitions has been given to reflective teaching by scholars. Hall (1997) defined it as a practice in teaching in which the teacher undertakes deliberate and sustained critical thinking and evaluation on actions for the purpose of improvement while Farrell (1998) and Ferraro (2000) defined it as the ability of teachers to subject beliefs and practices of their teaching to critical analysis. Reflective teaching requires a teacher to have awareness of classroom experience through observation, self-inquiry and critical thinking. The use of observation and critical thinking on what and why questions gives an individual teacher a certain power to determine the level of control that can be exercised over classroom practice. This in a way brings about a deeper understanding of the teacher's own teaching style, validation of the teacher's ideas which ultimately brings about greater effectiveness in a teacher and consequently leads to professional development of such teacher. Minott (2009) supported this view and defined reflective teaching as an attitude of self inquiry into one's practice and development of knowledge based on inquiry which is to observe and refine practice on an ongoing basis, thus resulting in continued professional growth. Regular inquiry into a teacher's practice of teaching could lead to regular refinement and flexibility in the teacher's classroom practice.

In reflective practice, the teacher applies the initial theory of teaching and learning in classroom practice, observe and critically consider and analyse the results to adapt the theory. Therefore, the classroom becomes a kind of laboratory where the teacher can relate teaching theory to teaching practice. According to Benson et al (2001) reflective practice involves seeing learning as an interactive process which plays an integral role in the action and learning from the action. It involves teachers to challenge their own assumptions and continue to develop their skills by learning from observed practice. Application of reflective teaching in classroom practice helps to free teachers from both

impulsive and routine behaviour. Butressing this, Farrell (2003) remarked that application of reflective teaching on classroom practice provides the means for teachers to build their daily experience, allows them to act in a deliberate critical and intentional manner, raises their awareness about teaching, enables deeper understanding and triggers positive change. Therefore, the classroom practice of a reflective teacher is usually a product of deliberate critical thinking decisions and actions which involves self examination and assessment through how and why questions of particular teaching. In view of this, Akbari and Allvar (2010) further reported that engaging in reflective teaching makes teachers to become better observers of classroom practice which stimulates an awareness of their teaching decisions and reasons behind those decisions. In turn, this understanding informs teachers' classroom approach and reduces their cognitive dissonance, makes them less inclined to rely on traditional practices and makes teachers not only consumers of knowledge but also primary producers of new knowledge. Therefore, reflective teaching requires a teacher to have an awareness of events in classroom practice. The regular inquiry in reflective teaching could be applied using various strategies.

2.2.4 Strategies of Reflective Teaching

The various ways or approaches through which reflective teaching is practiced are referred to as strategies of reflective teaching. Various strategies which have been identified by authors include thinking aloud (Taggart & Wilson, 2005), lesson recording (Richards, 1994; Tice, 2004; Pacheco, 2005; Taggart & Wilson, 2005; Ajitoni, 2008), journal writing/diary keeping (Richards, 1994; Hall, 1997; Tice, 2004; Pacheco, 2005; Taggart & Wilson, 2005; Ajitoni, 2008), story sharing/story telling (Hall, 1997; Bailey, 1997), 'critical friend' (Hall, 1997), brainstorming (Taggart & Wilson, 2005; Minott, 2009), students' feedback (Mohammed, 1995; Tice, 2004; Pacheco, 2005), mentoring (Hall, 1997), self report (Richards, 1994; Taggart & Wilson & Wilson, 2005; Ajitoni, 2005; Al-Issa & Bulushi, 2010), action research (Kailin, 1997; Bassoff, 2004; Pacheco, 2005; Farrell, 2009), focus group discussion (Taggart & Wilson, 2005; Farrell, 2009) and Peer observation (Hall, 1997; Tice, 2004; Pollard, 2005; Ajitoni, 2008).

Thinking aloud according to (Taggart & Wilson 2005) is deliberate and systematic reflection that is visible and audible. It involves putting observations about

teaching into personal verbal thought. Lesson recording on the other hand according to Tice (2004) is the use of audio or video recording of lesson to provide basis for reflection for many aspects of classroom teaching. This approach can capture moment to moment exchange which took place during a lesson thus providing useful information for reflection (Ajitoni, 2008). Journal writing/diary keeping as a strategy involves making reflection explicit through writing and thereby making them available to inform action. According to Farrell (2009) this strategy involves keeping a regular account of teaching experiences as well as straight forward description of events which may be used as basis for later reflection. Tice (2004) remarked that journal writing/diary keeping is the easiest way to begin a process of reflection since it involves writing of short note of events which took place during teaching. The note is usually written by the teacher who taught or the one who observed the events in the classroom for later critical analysis with colleague(s).

Bailey (1997) described story telling or story sharing as a strategy which involves narration of classroom events during teaching by a practitioner with colleagues for later reflection or critical analysis. While 'Critical friends' is a strategy which involves maintenance of a permanent reflective partner who is a trusted listener who they can consider their teaching together. Brainstorming according Taggart and Wilson (2005) as a strategy is critical thinking and rethinking of ideas on a given issue within time constraints by practitioners. Students' feedback is a strategy in which the opinions and perceptions of students thought about what goes on in classroom and new things they wished to be introduced are collected. According to Tice (2004), the collection could be achieved through verbal, simple questionnaire or learning diaries. Mentoring according to Hall (1997) is an approach in which a more experienced teacher constructively and critically considers and evaluates the teaching activities of a less experienced teacher (described as mentee). Self-report has been described by Taggart and Wilson (2005) and Ajitoni (2008) as a strategy involving a teacher completing an inventory on the teaching activities or classroom events. In the inventory, the teacher indicates the particular teaching practice to be used within a lesson for later critical analysis.

Action research on the other hand according to Kailin (1997) and Farrell (2009) involves undertaken a self inquiry into particular situations in order to improve one's own educational practice. Focus group discussion is another strategy which involves the bringing together of practitioners to discuss, critically consider, analyse, evaluate and reach conclusions on issues on classroom teaching events. Peer observation is when a pair of practitioners observed each other for later critical thinking and analysis. Teachers need to be knowledgeable about the steps involved in the process of reflective teaching to employ appropriate approach to become effective practitioners. In this study, the strategies of particular interest are focus group discussion and peer observation strategies.

2.2.4.1. Reflective Focus Group Discussion Strategy

Reflective focus group discussion strategy involves a group of teachers conveying for regular meetings to critically and systematically consider, analyse and evaluate the nature of teaching attitudes, beliefs, assumptions and practices of teachers (Taggart & Wilson, 2005). This is a form of cooperative and an on-going arrangement between few teachers to work together on their own personal and professional development. When the teachers come together to reflect, Farrell (2009) remarked that they can complement and compensate each other's strengths and compensate for each other's limitations.

According to Taggart and Wilson (2005) and Farrell (2009) reflective focus group discussion strategy is made up of the following steps:

1. Conveying of participants for a meeting. All the participating teachers will meet to plan the conduct of their classroom teaching. This would be done by discussion through consideration, analysis and assessment of their expected classroom events. One teacher is usually selected among the group as the facilitator to lead and coordinate the reflective activities in the group. The group would discuss the kind of material to be taught, the teacher's approach to teaching, the kind of students in the class, typical pattern of interaction and class participation, gathering of materials for teaching, and any problem that might be expected. Every member of the group will participate in the reflective discussion. At the commencement of meeting, the group is expected to choose a facilitator who

- leads the group to agreement and conclusion on a variety of different aspects of the lesson as reflected upon, such as organisation of the lesson, use of instructional materials, teacher's time management, teacher's questions and students' responses, classroom performance of both teacher and the students during teaching.
2. The classroom teaching: At this stage, each of the participating teachers goes to the classroom to teach his/her lesson as previously reflected and concluded upon during reflective discussion.
 3. Re-conveying of participating teachers for post classroom teaching discussions: After the classroom teaching, the teachers will re-convey again to reflect on the reports of the activities which took place in the classroom. Each teacher would give the report of his/her classroom events. The activities would be critically considered and analysed based on previous reflection to evaluate the consequences of the actions. A conclusion will be reached on each aspect considered on how such activities could be better carried out in the subsequent teaching.

In order to sustain the group, Pollard (2005) acknowledge that a level of trust must be developed among the members so that they can be open during group discussion without feeling the need to hide their opinions.

2.2.4.2 Reflective Peer Observation Strategy

This strategy provides opportunities for two teachers (colleagues) to pair up for critical and systematic consideration, of their teaching attitudes, beliefs, assumptions and practices. The teachers view each other's teaching in order to expose them to different teaching styles and provide opportunities for critical reflection on their teaching (Richards, 1992; Minnot, 2009). The strategy according to Richards (1992) and Tice (2004) involves the following steps:

1. Each participant will both observe and be observed: This is done working in pairs and taking turn to observe each other's classes during teaching.
2. Pre-observation orientation session: Just before each observation the two teachers would meet to discuss the nature of the classroom to be observed (i.e the materials

to be taught, approach to teaching, the kinds of students in the class, typical patterns of interaction, class participation and anticipated problems). Each teacher will assign the partner a goal for the observation and the task to accomplish. The task can include collecting information about some aspect of the lesson. The procedures or instrument to be used for the observation would be agreed upon and arranged during this session.

3. The observation: Each participant visits the partner's class and completes the observation using the procedures or instruments the two had on during pre-observation orientation session.
4. Post observation: After observation, the two participants would meet as soon as possible after the lesson. Each would report on the information that was collected from partner's classroom and discuss it through critical consideration, analysis and evaluation with the partner.

Richards (1992) remarked that this strategy helps teachers to obtain new insight into aspects of their teaching. Such insight may include awareness of the limited range of teaching strategies that have been in use, the need to develop better time management, better working relationship with a colleague, etc.

2.3 Empirical Review

2.3.1 Reflective Focus Group Discussion Strategy, and Teachers' Classroom Practices

Reflective Focus Group Discussion Strategy, involves group of teachers coming together for regular meetings to subject their beliefs and attitudes of teaching to critical consideration, analysis and assessment before and after teaching. Through critical thinking, teaching activities and events of teachers are consciously and systematically recalled, considered, analysed and evaluated for the purpose of improvement. This is done before and after teaching events in the classroom. Every teacher will participate in the reflective discussion with a teacher facilitator. Before classroom teaching, the reflective group meets to critically consider and analyse the teaching events that would take place in the classroom. There is generation of knowledge on various ideas on how teaching would be carried out in the classroom and other classroom issues. Thereafter,

the teachers go to the classroom to teach based on the previously agreed or concluded actions during reflection. After classroom teaching, the reflective group re-conveys to consider and analyse the event which occurred in the classroom. This is done systematically for the purpose of improving the next teaching. This implies that teachers' classroom practices are basically determined by reflective discussion or activities before and after teaching.

When teachers come together in such instances, various ideas about teaching are generated. This assists individual teacher in classroom practices. Farrell (2007) submitted that when a group of teachers reflect, various ideas are generated and better outcomes about classroom practices are achieved. During the reflective process, the group of teachers compliments each other's strength and compensate for each other's limitations. Through applications of critically considered, analysed and evaluated classroom instructions by individual teacher in classroom, the practice makes teachers present better performance in classroom practice. This supports Ferraro (2000) assertion that when teachers work together for group reflection, they are provided with suggestions from the group members on how to refine their teaching practice. The study explained further that reflective focus group discussion encourages teachers to challenge their preconceived views of teaching. Also, through participation in group reflective practice, Roig and Rivera (2013) noted that teachers are helped to modify their teaching strategies in classroom practice through their realization of the need to make changes in their teaching strategies to improve teaching learning process.

In this strategy, the practicing reflective teachers are opportune to have access to various ideas. Therefore, the strategy affects classroom practices of teachers by increasing and improving teachers' confidence and self efficacy in the classroom with various ideas generated during reflection to help in the process of teaching. Such ideas from group reflection, according to Farrell (1999) makes teachers become more confident agents of social change in classroom. This makes the classroom practice to be successful and dynamic. This is in collaboration with Goodell (2000) submission that reflective teaching is an essential skill for teachers and a powerful component of continuous dynamic and successful teaching.

The reflective focus group discussion strategy gives teachers the opportunity to articulate various thought about classroom practice, thus introducing flexibility into the classroom practice and ability to grow professionally. The classroom practices of teachers become dynamic in nature since teachers consciously and systematically subject classroom teaching to critical analysis and assessment. This is supported in separate studies of Mann (2005), Dantonio & Beisenherz (2001) and Farrell (2008) that reflective practice through focus group discussion strategy continually reshape teachers' knowledge of teaching and classroom practice since various ideas applied in classroom are generated during reflection. In this instance, the teachers grow professionally since a level of trust is experienced among the participating teachers with open discussions without the feelings of the need to hide their opinions. Little wonder why Farrell (2000) remarked that effective teacher professional development should involve more than seminar, but continuous examination of their assumptions and beliefs.

2.3.2 Reflective Peer Observation Strategy and Teachers' Classroom Practices

Reflective Peer Observation Strategy is a reflective teaching strategy which provides opportunities for two teachers (colleagues) to view each other's teaching in classroom for later reflection. The teachers meet regularly to subject their teaching beliefs, attitudes, assumptions and practices to systematic and critical consideration, analysis and assessment before and after teaching. The teachers work in pairs and take turns to observe each other's classes. Before each observation the two teachers would meet to critically think, consider, analyse and evaluate the nature of classes to be observed. Ideas would be generated and systematically considered and concluded on events during classroom practice (e.g kind of materials to be taught, approach to teaching, instructional materials to use, anticipated problem etc). The nature of the classroom practice would be concluded and agreed upon by the two reflective teachers. Thereafter, during teaching, each participant will both observe and be observed using the agreed procedure during reflection. After teaching, the two teachers meet; report the information collected in each other's classroom and systematically consider, analyse and evaluate it through critical thinking based on previously agreed procedure. Weak or failed

procedures are removed and new knowledge or ideas are constructed for better performance in future classroom practice.

In this way, as the two practitioner teachers reflect on their own teaching practice, the feedback received enables them to make changes to improve their teaching. This is in support of University Teaching Development Center (2004) remark that peer observation strategy of reflective teaching is used as a way of improving teaching and learning since all aspects of teaching – classroom practice and students’ learning are involved. The study further submitted that peer observation helps to improve the quality of teaching and learning through open discussion and systematic critique. Reflective peer observation is also said to provide a more comprehensive evaluation of teaching by examining every aspect of classroom practice. Butressing this view, Farrell (2008) remarked that, reflective practice by peer observation strategy introduces flexibility in the classroom practices of the two reflective teachers. This is due to direct observation of the activities of each participating teacher’s classroom and later sharing through reflective discussion of the teaching act to improve teaching. During observation, the teachers are able to identify varieties of different aspects of partner’s lesson which offers opportunities for thorough reflection on every aspect of classroom practice of each teacher which will improve next experience in the classroom. In support of this assertion, Amobi (2005) and Farrell (2007) acknowledged that the direct observation in reflective peer observation strategy enables the participating reflective teachers to gain a number of insights about their own teaching from colleague’s observation. Cakir (2010) also reported that through peer observation, teachers’ can gain insight into aspects of their teaching in the following ways:

- (i) obtain more detailed information on students’ performance during specific aspects of the lesson that teacher concentrated on.
- (ii) reveal unexpected interaction between students during a lesson.
- (iii) revise the teaching strategies they use.
- (iv) revise and develop better time management strategies.
- (v) revise and develop a better working relationship with colleagues.

- (vi) come up with new ideas from observed classroom practice during post observation discussions.

Since the strategy involves observation of partner's classroom, Bolton, (2010) reported that this may give the observer (the teacher observing the other at a time in classroom) a chance to learn a new skill or technique that has not already mastered by such teacher. During reflective discussion the observer is expected to be allowed to articulate what has been learnt. In spite of this, peer observation strategy has been reported by Malderez (2003) to have other benefits on teachers' classroom practice such as:

- (i) teachers being able to learn and support each other.
- (ii) the reflective discussion helps teachers to reflect on their teaching and explore the implicit reasons and beliefs that underline their behaviours in the classroom.
- (iii) Observation can help teachers develop their ability to notice what happens in the classroom and to explain why things happen and this in turn could lead to improvement in students' learning
- (iv) It can expose teachers to different styles of teaching which lead to enrich their experiences.

As a result of the information collected from observation, teachers would identify aspects of classroom practice which would need to be changed and therefore, affecting the classroom practice through positive improvement. A continuous engagement in reflective peer observation strategy would bring about the continuous refinement of classroom practices of the paired practitioners thus leading to improvement in teaching in classroom.

2.3.3 Reflective Focus Group Discussion Strategy and Students' Achievement in Biology

Reflective Focus Group Discussion strategy is a form of reflective teaching in which teachers gather together to subject their practices of teaching or teaching actions to critical analysis and evaluation. This is usually done through conscious critical questioning and consideration of the teaching activities by all the participating teachers in the group to make their teaching better. Farrell (2007) described reflective focus group

discussion strategy as deliberate and sustained critical thinking, consideration, analysis and evaluation of teaching actions undertaken by teachers for the purpose of improvement. During critical questioning, consideration and analysis of biology class, various ideas which lead to creation of knowledge on classroom practices of the biology teachers are generated. This leads to effectiveness of such teachers in their practice since these reflective activities affect both the classroom practices of the teachers and the achievement of the students when the teachers put into practice the knowledge created from ideas generated during reflection. Just as the classroom practices of the biology teachers becomes better in reflective practice through freedom of teachers from both impulsive and routine teaching behaviour, students learning is also stimulated towards positive change. Thus, students' achievement becomes better since teachers according to Akbari and Allvar (2010) are among the most important players influencing students' achievement, holding the key to sealing the gaps in students' learning outcome. Supporting the view of corresponding improvement of teachers to students' improvement in academic achievement in reflective teaching, Goldhaber (2002) also claimed that reflectivity of teachers is the widely recognised as one of the most important factors influencing students' achievement.

In Reflective Focus Group Discussion strategy, the population of teachers who carry out reflection process encourages generation of various ideas and creation of knowledge on biology classroom. These various ideas offers multiple opportunities for the participating teachers' for critical analysis which may later lead to changes in the classroom practices as modified during reflection to make teaching better. Therefore, the effect on classroom practices may in turn be felt on students' learning and consequently on their achievement. This statement is supported by the findings of Lowery (2003) that reflective teaching practices have the potential to affect students' achievement in science classroom especially biology.

A regular practice of reflective teaching by focus group strategy as describe by Richards (2000) has the potentials to move teachers beyond the level of routinised responses to classroom situation to a high level of awareness of one's teaching than what could be achieved by an individual teacher. In corresponding way, students' learning may

also be moved from regular responses to achievement probably to a higher level in biology as Farrell (2008) concluded that in such case, better outcomes which may not be achieved by an individual teacher are experienced. This is possible since through this strategy of reflection, the group of teachers can react, examine and evaluate their teaching to make rational decisions about necessary changes to improve attitudes, beliefs and teaching practices which lead to better students' performance and achievement than could be achieved by a single teacher. Key (2006) in supporting the possibility of teachers' group reflection in improving students' achievement remarked that group members collaborates with each other in sharing ideas on teaching, students' work, discuss problems, working to develop materials and seek to continually experiment the ideas generated and gathered from such reflection, in classroom teaching in order to learn and improve with a sense of efficacy on how to best meet the needs of their students. In biology classroom this situation would tend to move the teachers toward high effectiveness and as such lead to higher academic performance as Hoglund and McClung (2012) acknowledged that students of highly efficient teachers learn and scored high in science and mathematics.

2.3.4 Reflective Peer Observation Strategy and Students' Achievement in Biology

Reflective Peer Observation strategy involves only two teachers in the process of reflection. According to Hall (1997) and Farrell (2008), reflective peer observation strategy, enables two teachers to come together and help each other articulate their thoughts about classroom practices and students' learning. The teachers take turn to observe each other's teaching and follow up with constructive reflective discussion about what was observed. The two biology teachers involved in this strategy help to articulate each other's thoughts about biology class while preparing for their classes. This is done through critical questioning, analysis and consideration of how the teaching will take place and how the students will learn in the biology classes. After the two teachers take turn to observe each other while teaching, constructive criticism with reflective discussion on observations on classroom practices which could improve their practice followed in relation to previous reflection.

Since such discussion is constructive in nature, it is aimed at improving subsequent teachings as this process continues. Cohen and Hill (2001), Farrell (2008) and Marzano and Toth (2012) remarked that such practice can achieve outcomes that may not be possible for an individual teacher working alone. Buttressing this view, Kay (2006) acknowledged that teachers involved in reflective peer observation strategy have a higher sense of efficacy and responsibility in their teaching and can affect students' achievement positive especially when they figure out how to best meet the needs of their students. This implies that a better outcome may be observed in teacher's classroom practice and students' achievement when two teachers question their own teaching after classroom observation. Such outcomes would include its effects on teacher's classroom practices, students' learning and achievement. Since the two biology teachers would put into practice those things discussed and concluded upon during reflection this may have effect on teacher's classroom practice as well as students' learning and consequently on students' achievements. This is supported by Stewart and Richardson (2000) that there is direct influence of teachers' reflectivity on student's achievement. Such reflective peer observation strategy will provide quality instruction and teacher's efficacy in the two teachers which may influence students' success and achievement in the biology teachers' classrooms.

The two biology teachers involved in the reflective discussion may generate more ideas about classroom teaching during reflections especially after classroom observation of each other's teaching compared to ideas generated by a single biology teacher who may not have a careful observation of his or her classroom teaching for reflection. In agreement to the above statement, Stewart and Richardson (2000) and Akbari and Allvar (2010) submitted that better outcome is achieved in students' achievement of teachers who carried out peer reflection than students' achievement of a single teacher's reflection. The two studies further reported that there is a high correlation between teachers' reflectivity and students' achievement. This implies that the level of biology teachers' reflection on classroom practice may determine the influence on students' achievement. Since new ideas on classroom practice of teachers as it affects students' achievement are always searched into by reflective teachers, peer observation strategy has the potential to affect students' achievement with new ideas of teaching.

2.3.5. Teachers' Reflective Teaching Knowledge and Classroom Practices

Reflective teaching knowledge is the understanding of the theory of reflective teaching. It involves actual understanding of the skills of basic rudiments and details of different strategies of the practice of reflective teaching. According to Navaneedhan (2011) reflective teaching involves questioning one own self teaching to bring perfection. It is a kind of self examination involving engaging in deliberate and self criticism with the purpose of refining one's teaching practices. The deliberate examination and criticism involves questioning through critical analysis and evaluation of one's teaching beliefs, assumptions, attitudes and practices. The understanding of the systematic process in such questioning is referred to as reflective teaching knowledge. Classroom practice on the other hand is all activities teachers carry out in the classroom in the process of teaching and learning.

Application of the theory of reflective teaching in classroom practice has the possibility to make the classroom becomes a kind of laboratory where teachers can relate theory to practice. Acquisition of reflective teaching knowledge by teachers is important for its adequate application in classroom practice. However, mere possession of reflective teaching knowledge skills by teachers may have no effect on classroom practices of such teachers. Engaging in reflective teaching which is associated with improvement and stimulation of personal and professional growth, thereby bridging the gap between theory and practice could be profiting to teachers' classroom practice. Supporting this view, Lieberman and Miller (1999) pointed out that, there is need to integrate the theory of the knowledge of reflective teaching into classroom practice. The scholars stressed further that such integration would likely affect the practice of teachers in the classroom during teaching as a means of professional development.

The importance of integration of reflective teaching theory into classroom practice is also observed in the findings of Cohen and Hill (2001) on professional development programme on science and mathematics teachers where it was found that instructional practices were changed and teaching skills were improved when the theory was linked directly with daily experiences. The implication is that when reflective teaching knowledge as professional development programme is linked directly with daily

experiences of biology teachers the classroom practices of the teachers have the potential to improve. Supovitz and Turner (2000) concluded that professional development is seen as the best way for changing teaching practices in sciences when it focuses on instructional practices that are specifically related to the subject matter.

2.3.6 Teachers' Reflective Teaching Knowledge and Students' Achievement in Biology

Teachers have been identified as the most important or principal factor having influence on students' achievement. Akbari and Allvar (2010) and Akiri (2013) submitted that substantial research base acknowledged that teachers have great impact on students' achievement. The academic performance of students is majorly determined by the teachers since they are responsible for translating educational policies and principles into actions. In this respect, Wabuke et al (2013) also acknowledged that teachers' related factors influence students' performance in biology. It implies that teachers are main determinant of students' success in academic achievements of biology. They hold the major key of students' achievement in the subject. Therefore, the extent of knowledge acquired by these teachers for the execution of teaching activities is also important for the effect of efficacy of the teachers on students.

The depth of the knowledge the teachers possess determines what and how efficient their teaching activities would be since they cannot offer what they do not possess. In order to become effective and efficient, teachers must be able to critically examine the teaching activities. This is better achieved through the practice of the knowledge of reflective teaching since according to Ahmad et al, (2013) reflectivity is the essence of quality teaching and learning. When quality teaching and learning is attained, such teachers become effective and thus produce students with better academic achievement. Hoglund and McClung (2012) claimed that students with effective teachers learn and scored higher than students assigned to ineffective teacher in mathematics and science. Lowery (2003) also remarked that reflective teaching brings about efficacy in teachers' practice which in turn influences or affects students' achievement in sciences and mathematics. This implies that reflective teaching knowledge has the tendency of

influencing students' achievement in science and mathematics which is also applicable to biology which is a science subject.

Sanders (2000) and Stedwart and Richardson (2000) also submitted that reflective teaching knowledge can influence teachers' classroom practices significantly and lead to improved students' achievement when it focuses on how students learn subject matter, instructional practices that are specifically related to how students learn and strengthen of teachers' knowledge of specific subject matter content. Acquisition of knowledge of reflective teaching in relation to the aforementioned, for the purpose of developing professionally has the tendency of improving students' achievements if effectively applied in classroom practices. Through reflective teaching much is revealed about the learning components of teacher knowledge and pedagogical content knowledge which lead to professional improvement of teachers. Considering the importance of professional development of teachers on students, Marzano and Toth (2012) remarked that even small improvements in teachers' effectiveness can have a positive impact on students' achievement in sciences (Biology inclusive). Therefore, through acquisition and practice of the skills of reflective teaching knowledge, biology teachers could influence students' achievement positively.

2.3.7 Teachers' Gender and its Influence on Teachers' Classroom Practices

Classroom practices are activities engaged in by teachers in classroom in the process of teaching and learning. According to Kauchak and Eggen (2007) and Mellado (2008) such classroom practices include communication style (both verbal and non verbal), questioning style, use of instructional materials, time management. Every teacher is expected to perform the above mentioned practices in the process of teaching and learning in classroom irrespective of gender having acquired relevant pre-service professional training. The indication is that every teacher is expected to carry out the professional obligations as trained not minding the gender difference. Carrell et al (2010) remarked that there is no firm evidence of difference in teachers' classroom practice efficiency based on gender.

However, certain differences have been observed in the execution of teachers' duties in the classroom. Tsourouff (2002) and Ifegbesan (2010) remarked that secondary school teachers hold some stereotyped views and practices in classroom. The scholars revealed that there are significant differences between the gender's stereotyped beliefs, attitudes and practices of male and female teachers. The implication of this finding is that there are differences in the way male and female teachers view and apply teaching skills in classrooms due to some stereotyped gender beliefs and attitudes about students. Also supporting differences in the classroom practices of teachers with respect to gender, Antecol et al (2012) recorded significant differences in teachers' self perceived assessment skills with male teachers having a higher assessment skills in classroom practice than the female teachers. Buttressing this finding, Chudgar and Sankar (2008) acknowledged that male and female teachers differ in terms of classroom practices and beliefs in students' learning ability though the differences may sometimes be mediated by subject taught. Nevertheless, some studies (McNergney & McNergney, 2006; Kauchak & Eggen, 2007; Mertler, 2011) have reported that there is no gender difference in teachers' classroom practices.

2.3.8 Teachers' Gender and Its Influence on Students' Achievement in Biology

Teachers are important factors in students' achievement. Sanders (2000), Alexander and Fuller (2005) and Akbari and Allvan (2010) acknowledged that there is substantial evidence that the most important player influencing students' achievements are the teachers. Teachers have been found to play important role in determining students' achievement in all subjects. However, studies (Chudgar and Sankar, 2008; Elstad and Turmo 2009; Dobbie, 2011) have further showed that gender has significant effect on teachers' influence on students' achievement. Dee (2006) submitted studies that students react to teachers' gender in learning. The studies reported that male students tend to perform better than female students with male teachers while female teachers were reported to have a positive effect on girls' achievement but negative effect on boys' achievement in sciences. This implies that students perform better when allocated to class with teacher of the same gender in science (Biology inclusive). Still stressing teacher's gender influence on students' achievement, Dee (2005), Dee (2007), Elstad and Turmo

(2009) and Split et al (2012) remarked that teacher's gender significantly affect students' performance in sciences. These scholars submitted that assignment to the same gender teacher significantly improves the achievement of both girls and boys while assignment to an opposite gender teacher lowers students' achievement in sciences and mathematics. The findings of these studies showed that students assigned to teachers of the same gender have the tendencies of improving their achievement scores while assignment to an opposite gender teacher may lower students' achievement in sciences and mathematics. This may also be applicable to biology since it is a science subject. It implies that boys in male teacher's class have the potential to have better achievement than the female counterparts in the same biology class and vice versa.

Contrary to the above submission, Antelcol et al (2012) reported that female students assigned to a female teacher without a strong mathematics background suffered lower achievement scores in mathematics and sciences and no effect of female teachers on male students' scores. These findings explained that effect of female teacher on female students in mathematics and sciences depends on teacher's strength in the subject matter while there is no gender effect of teacher on achievement scores of male students. These findings may also be applicable to Biology as a science subject. However, Ajala and Alonge (2013) discovered that there is no gender difference in students' performance in science subjects in relation to teacher's gender. Buttressing this discovery, Chudgar and Shankar (2008) remarked that being in female teacher's classroom is advantageous only in language learning but teacher's gender has no effect on mathematics and science learning in students. This means that there is no teacher's gender influence on students' achievement in sciences. Therefore, the level of acquisition of knowledge and subsequent performance of students in such knowledge of science may depend on other factors but not on teacher's gender.

2.4 Appraisal of Literature Reviewed

The literature reviewed in the area of study showed that teachers have been criticised for failing to approach lessons with dynamism, thereby having routine response to classroom situations. Though the teachers have been found to plan class lessons, they do not take time to critically and systematically consider, analyse and evaluate the pre-

planned classroom activities through reflections. Consequently, they are unable to critically evaluate the teaching delivery process necessary to make crucial decisions about what should be done in subsequent classes. The practice of reflective teaching has been identified as solution to this routine response to classroom situations as it has proved effective for reshaping and improving teachers' classroom practices and thereby helping to support their professional development and improve students' achievement.

Many existing research works on reflective teaching have focussed on pre-service teachers and have revealed that reflective teaching improved students' performance in micro teaching and teaching practice. These studies on pre-service teachers used varied strategies such as journal writing, lesson recording, story sharing, peer observation, critical friend, mentoring and action research. Though the studies used different strategies, the reports revealed an improvement in the pre-service teachers' micro practice and teaching score. The teaching practice rating scales in the sampled institutions were used to measure and compare the teaching of the pre-service teachers before and after exposure to reflective teaching. However, none of the studies reviewed measured the influence of the improvement of the pre- teachers' teaching on the students taught.

The few available research works on reflective teaching among in-service teachers are mostly on language teaching. These studies recorded the use of journal writing, students' feedback, lesson recording, teaching diary, critical friend and story sharing. The results of the studies revealed improvement in teachers' classroom practices with reflective teaching using observation scale to observe and measure teachers while teaching. In addition, few studies on computer science and physics using mentoring and lesson recording strategies respectively revealed that reflective teaching leads to improved classroom effectiveness among teachers. In spite of these results on in-service teachers' improvement in classroom performance, the effects of such improvement of the teachers on students' achievement were not measured. Therefore, this study examined the effect of other strategies as reflective focus group discussion and reflective peer observation on teachers' classroom practice and the corresponding effects of these on the students' achievement which literature has failed to consider. However, the study also measure teachers' performance in classroom with observation scale as in earlier studies, but designed another instrument to measure students' achievement. Though, the literature

reviewed indicated the importance of teachers' gender in the acquisition of pedagogical knowledge for classroom practice, existing studies on reflective teaching have failed to consider the significant effects of teachers' gender and knowledge on classroom practice and students' achievement. Thus, the need to address the moderating effects of teachers' gender and reflective teaching knowledge in this study.

In Nigeria, available studies on reflective teaching are mostly among pre-service teachers. To the best of the researcher's knowledge, no research study is available on reflective teaching among in-service science teachers, especially in biology and its effectiveness on students' performance. This study therefore, determined the effects of two strategies of reflective teaching- reflective focus group discussion and reflective peer observation on biology teachers' classroom practices and its effects on students' achievement.

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CHAPTER THREE

METHODOLOGY

This chapter deals with the methodology employed in the study. This includes the research design, variables of the study, selection of participants, instruments, research procedure as well as the statistical tools used in the collection of data and data analysis.

3.1 Research Design

The study employed the pretest-posttest, control group, quasi- experimental design.

The design is symbolically represented as

O_1 X_1 O_4 Experimental Group 1
 O_2 X_2 O_5 Experimental Group 2
 O_3 X_3 O_6 Control

Where O_1 , O_2 and O_3 represent the pretest for the experimental groups 1, 2 and control group respectively. O_4 , O_5 and O_6 represent the posttest for the experimental groups 1, 2 and control group respectively.

X_1 Treatment for group 1 involving Reflective Focus Group Discussion strategy (RFGD).

X_2 Treatment for group 2 involving Reflective Peer Observation Strategy (RPO).

X_3 ----- Control Group involving convectional method without systematic reflection.

The study used 3x2x2 factorial matrix presented in Table 3.1.

Table 3.1: 3x2x2 factorial matrix

Treatment	Gender	Teachers' Reflective Teaching Knowledge	
		Low	High
Reflective Focus Group Discussion Strategy.	Male		
	Female		
Reflective Peer Observation Strategy.	Male		
	Female		
Conventional Method.	Male		
	Female		

3.2. Variables in the Study

The variables in this study are:

1. Independent Variable- Reflective Teaching at three levels:
 - a) Reflective Focus Group Discussion Strategy.
 - b) Reflective Peer Observation Strategy.
 - c) Conventional Method.
2. Moderator Variables
 - a) Teachers' Reflective Teaching Knowledge at two levels (Low and High).
 - b) Teachers' Gender at two levels (Male and Female)
3. Dependent Variables
 - a) Teachers' Classroom Practices.
 - b) Students' Achievement in Biology.

3.3. Selection of Participants

A simple random sampling procedure using lot casting was adopted in selecting three local government areas from eleven local government areas in Ibadan metropolis of Oyo state. All the schools within the three local government areas were subjected to scrutiny based on the following criteria:

- (i) presence of separate laboratory for teaching biology
- (ii) availability of minimum of two biology teachers teaching biology in Senior Secondary School II (SS II)
- (iii) evidence of completion of SS I biology syllabus
- (iv) a co-educational school. In all, 25 schools met the criteria in the three local government areas.

Thereafter, three schools were purposively selected from each local government area and were randomly assigned to two experimental groups and one control group. Furthermore, the two SS II biology teachers in each school and their students were purposively selected for the study. One intact class was randomly selected per teacher in each school. In all, a total of 18 biology teachers (6 teachers per treatment and control groups) and 576 biology students (RFGD=174, RPO= 210, Control= 192) made up of both male and female students participated in the study.

The SS II biology teachers and students in each school were purposively selected for the study. This is because

- 1) the teachers and students were likely to have a fairly stable classroom teaching and learning environment as they would not be under pressure preparing for the final Senior Secondary Certificate Examination.
- 2) the teachers should have taught biology for a minimum of two years.
- 3) the biology teachers would have attained some consistency in their teaching behaviours or patterns.
- 4) the biology teachers would be qualified teachers with professional training possessing B.Ed (Biology) or B.Sc (Biology) with Post Graduate Diploma in Education (PGDE)

A reflective focus group was constituted in each school for treatment 1. This group consisted of all the science teachers - one teacher each of chemistry, physics, agricultural science, mathematics, two SS II biology teachers and an observer. A total number of seven participants formed the focus group in each of the treatment 1 schools. The head of the science department acted as the facilitator. The groups were involved in reflective discussions before and after teaching events of the sampled biology teachers in the classroom respectively.

The two SS II biology teachers formed the participants for reflective peer observation strategy in schools for treatment 2.

3.4. Choice of Teaching Content

The researcher went through past questions of Senior School Certificate Examinations in biology of both the West African Examinations Council (WAEC) and National Examinations Council (NECO) of the last eight years and discovered that questions are regularly set on ecology. The researcher further went through WAEC Chief Examiners' Report and discovered that it was stated that answering of questions on ecology is not popular among candidates and where they occur, students' performance is poor (Chief Examiners' Report, 2005, 2006, 2007, 2010). This collaborates Ige (1998) finding that Ecology is a difficult concept for learners to learn.

Therefore, based on the above reasons, the choice of topic taught for the study is ecology. The concepts or sub-topic taught under this topic include aquatic habitat-marine, estuarine or brackish water and freshwater, terrestrial habitat – desert, savannas and forest vegetations.

3.5. Research Instruments

The following instruments were used for the study:

1. Teachers' Instructional Guide for Reflective Focus Group Discussion Strategy (TIGRFGD).
2. Teachers' Instructional Guide for Reflective Peer Observation Strategy (TIGRPO).
3. Teachers' Instructional Guide for Conventional Method (TIGCM).
4. Teachers' Classroom Practice Observation Scale (TCPOS)
5. Instructional Guide for Facilitators (IGF).
6. Instructional Guide for Observers (IGO)
7. Biology Teachers' Reflective Teaching Knowledge Test (BTRTKT).
8. Students' Achievement Test in Biology (SATB).

3.5.1 Teachers' Instructional Guide for Reflective Focus Group Discussion Strategy (TIGRFGD)

This instrument was adapted from Tice (2004), Pollard (2005) and Farrell (2010). The instrument was used as a guide by teachers for reflective activities by focus group discussion strategy. The instrument is made up of two parts. The first part contains items guiding reflective activities of the biology teachers' classroom activities such as communication style, use of instructional materials, questioning and time management before teaching while the second part contains items guiding the reflective activities on the classroom practice after teaching.

3.5.2 Validity and Reliability of TIGRFGD

This instrument was given to experts in research and biology teaching for content and face validation. Corrections, comments, criticisms and suggestions were made by these experts. The experts reacted by commenting on the clarity of language and the ability of the items to measure what they are to measure. Hence, some items were reframed. Reliability was done by inter-rater reliability. Here, the instrument was administered three times to a group of science teachers who are not part of the sample and its effectiveness measured. The instrument was administered to ensure the guide is measuring what it is set out to measure. Five raters were appointed to observe and rate every aspect of the strategy as implemented. The inter-rater reliability was then estimated using Scott's \bar{u} . The inter-rater reliability index obtained was 0.82.

3.5.3 Teachers' Instructional Guide for Reflective Peer Observation Strategy. (TIGRPO)

The instrument was developed by the researcher by adapting the procedure for reflective teaching by peer observation described by Florez (2001), Tice (2004) and Pollard (2005). The instrument served as a guide for reflective activities for peer observation strategy. The instrument is made up of two parts. The first part contains items guiding reflective activities for the biology teachers' classroom activities (i.e communication style, use of instructional materials, questioning style and time management) before the teachers go to the class to teach. The second part is made up of items guiding reflective activities on teacher's communication style, use of instructional materials, questioning style and time management after teaching.

3.5.4 Validity and Reliability of TIGRPO

The instrument was given to experts in research field and biology teaching who subjected it to corrections, criticisms, comments and suggestions for face and content validity. The experts corrected the language clarity of some of the items and reframed some of the items to ensure the activities are correctly carried out during the study. Thereafter, the instrument was applied to a group of biology teachers who are not part of the sample and its effectiveness measured. Five raters were appointed to observe and

record every aspect of the strategy and their ratings were implemented according to plan. This was done to ensure that the guide measured what it was out to measure. The inter-rater reliability was estimated using Scott \bar{u} . The inter-rater index obtained was 0.80.

3.5.5. Teacher's Instructional Guide for Conventional Method (TIGCM)

The instrument was developed by the researcher. It contains items guiding the conventional method of teaching by teachers. This was used by the teachers in conventional strategy to teach their students in the control group.

3.5.6 Validity and Reliability of TIGCM

The instrument was given to experts in research field and biology teaching who subjected it to comments, criticisms and suggestions for face and content validity. The experts corrected some of the items on clarity of language, hence some items were refamed. Some items were removed while few were also suggested by the experts to ensure the instrument is adequate to guide the teachers in conventional method. Thereafter, the instrument was applied to a group of biology teachers who are not part of the sample and its effectiveness measured. This was done by appointing five raters to observe the teachers and rate the use of the instrument to ensure the instrument was implemented according to plan. The inter-rater reliability was estimated using Scott \bar{u} . The inter-rater index obtained was 0.85.

3.5.7 Teacher's Classroom Practice Observational Scale (TCPOS)

This instrument was adapted by the researcher based on the studies of Murray (1983), Shalaway (2005) and the University of Ibadan Teaching Practice Rating Scale. It was designed to record systematic observations of the classroom practice (i.e communication style, use of instructional materials, questioning and time management) of the sampled biology teachers while teaching. The instrument is made up of two parts. Part one contains the teacher's data and list of activities in tabular form with regards to content, intended learning and how learning should be accomplished by the sampled teachers during teaching. These are based on variables considered as classroom practices (i.e communication style, use of instructional materials, questioning and time

management) in the study. Part two is made up of guides for scoring the observed classroom activities of the biology teacher.

The instrument was used to train the observers on how the observation of teachers took place in the classroom. Each item in the instrument was read out and explained to the observers by the researcher during the training. The researcher demonstrated the scoring process with the use of the instrument with a videotaped lesson as part of the training.

The observations, recording and scoring were done by trained observers for each sampled biology teacher per lesson. A tick was given in the appropriate column to indicate the observed behaviours of the teacher. The scoring was done as follows: 5-very good, 4- good, 3- very fair, 2- fair, 1- poor as indicated under each item in the scoring guide for TCPOS. A tick (✓) was indicated in the appropriate space as provided in front of each item.

3.5.8 Validity and Reliability of TCPOS

The instrument was presented to experts in biology teaching and research for comments, criticism and suggestions. The experts reacted by commenting on the clarity and language of each item. They also indicated how each item is related to the classroom practices being considered in the study. The final draft was administered to three SS II biology teachers who were not part of the participating teachers to determine the reliability of the instrument. Five raters were appointed to observe the teachers and rate the instrument to ensure the instrument measured what it was out to measure. The ratings were compared and the inter-rater index was estimated and determined by using inter-rater reliability. The inter-rater index estimated using Scott \bar{r} was 0.80.

3.5.9 Instructional Guide for Facilitators (IGF)

The instrument was adapted by the researcher from Tice (2004) and Farrell (2010). It was developed as a guide for facilitators during reflective process of reflective focus group discussion strategy. It contains items which guided the facilitators

to initiate and coordinate the reflective activities and process of the focus group discussion strategy.

3.5.10 Validity and Reliability of IGF

The instrument was given to experts in research for face and content validation and necessary corrections and suggestions were made. The experts ascertain the suitability of the items with reference target population and in terms of clarity of language. The instrument was applied to facilitators of groups of science teachers who were not part of the sample and its effectiveness measured alongside with TIGRFGD. Five raters were appointed to observe the facilitator and rate the instrument to ensure the guide was implemented according to plan. The ratings were compared and comments from the observers and facilitators were compared and discussed. Thereafter necessary modifications were made and its reliability was determined by inter-rater reliability using Scott \bar{r} and the inter-rater index was estimated at 0.72.

3.5.11 Instructional Guide for Observers (IGO)

This instrument was developed by the researcher to guide the observers on what and how to observe and score the sampled biology teachers during teaching using TCPOS. The instrument contains items which guided the observers on the procedure for observation of sampled biology teachers during teaching. The guide was developed to guide the observers on how to observe and score the sampled teacher using the observational scale.

3.5.12 Validity and Reliability of IGO

The instrument was presented to experts in research for correction, criticism, suggestions and modifications. Considering the target population, some of the items were reframed while some were replaced by the experts with respect to clarity of language. The reliability was determined by inter-rater reliability. It was applied to observers who were not part of the sample and its effectiveness measured. Five raters were appointed for each observer to observe and rate the use of the instrument to determine the reliability. Comments from the observers and raters were compared, discussed and necessary

modifications were made. The ratings were compared and the inter-rater index was determined by using inter-rater reliability. Thereafter, the inter-rater index was estimated using Scott \bar{u} and it stood at 0.70

3.5.13 Biology Teachers' Reflective Teaching Knowledge Test (BTRTKT)

The instrument was adapted by the researcher from Mansaray and Ajiboye, (1997). It was designed to assess biology teachers' knowledge of reflective teaching. The instrument is made up of two sections. Section A contains demographic data of the observed teacher i.e teacher's bio-data - name of school, gender, qualifications, years of experience, subject taught and class level. Section B contains fifteen multiple choice questions on knowledge of reflective teaching with four options (A, B, C and D) following each item from which the teachers were expected to select one correct option. The instrument was administered to sampled biology teachers in each of the selected schools during the pre test and posttest.

3.5.14 Validity and Reliability of BTRTKT

The instrument was given to experts in research field in education for comments and input. Thereafter, the final draft was administered to twenty biology teachers who did not participate in the study. Their scores were subjected to item analysis in order to determine the difficulty level and discriminating power of each item of the test. Items with difficulty index of 0.48 and discrimination indices between 0.40 and 0.65 were retained. This reduced the initial 20 items to 15. The reliability coefficient of the 15 items was then determined using Kuder-Richardson (KR 20). The reliability coefficient was found to be 0.85.

3.5.15 Students' Achievement Test in Biology (SATB)

SATB was developed by the researcher using past questions of the West African Examinations Council (WAEC) in biology. It is a multiple choice objective test. This tested students' achievement in ecology based on all the concepts which were taught. It was administered to students during pre-test and posttest. The test consists of two sections A and B. Section A seeks personal information of students with respect to name,

age, gender and school. Section B consists of twenty-five (25) multiple choice questions with four alternatives, A, B, C and D. Each correct response to the multiple choice questions was awarded 1 mark. Test contents cover the concepts of ecology in three levels of cognitive domain of knowledge, understanding and thinking.

Table 3.2: Table of Specification for Test Items in SATB

Aspect of Topic	Knowledge	Understanding	Thinking	Total
Marine Habitat	6, 17, 25	14, 15	11, 19	7
Freshwater Habitat	4, 12	8, 9, 20	5, 10	7
Estuarine Habitat	2, 16	3, 18,	13, 24	6
Terrestrial Habitat	7, 1	21, 23	22,	5

3.5.16 Reliability and Validation of SATB

The instrument was given to experts in biology teaching for comments and input. Thereafter, the final draft of the instrument was administered to forty SS II students of a school which did not participate in the main study. The scores were subjected to item analysis in order to determine the difficulty level and the discriminating power of each item of the test. Items with difficulty level of 0.54 and discrimination indices of between 0.45 and 0.62 were retained. 25 items were left. The reliability coefficient of the 25 items was determined using Kuder-Richardson (KR 20) formula which yielded a reliability value of 0.86.

3.6. Procedure for Data Collection.

The researcher purposively selected nine schools from three randomly selected three local government areas in Ibadan metropolis. The local inspector of education offices of the schools were visited for collection of list and location of senior secondary schools in each of the local government areas. The schools were visited to ascertain their eligibility to participate in the study based on the criteria for selection. Three schools

were purposefully selected from each of the local government areas based on the criteria. The schools were randomly assigned into two experimental and one control groups.

Thereafter, the researcher visited the principals of selected schools to seek permission, meet the vice-principal for academic, heads of science department, SS II biology teachers and other science teachers, for discussion, cooperation and collection of SS II time table. The teachers used for the study were the biology teachers assigned to teach the SS II classes by the school authority.

At the start of the study, Biology Teachers' Reflective Teaching Knowledge Test (BTRTKT) was administered to all the sampled biology teachers and achievement test to the biology students in each of the selected schools. This was the pre-test. During this stage also, the sampled SS II biology teachers were observed and scored by the trained observers using TCPOS. The observers were trained using TCPOS. Each item in the instrument was read out and explained to the observers by the researcher during the training. The researcher demonstrated the scoring process with the use of the instrument with a videotaped lesson as part of the training. The Instructional Guide for Observers was also used in the training of the observers. The researcher read out the items in the instrument (i.e IGO) and explained each one after the other. In order to ensure clarity on the training, the observers were requested to ask questions from the researcher and were also asked questions.

Thereafter, the teachers in each treatment group were trained on how to carry out reflective practice before and after classroom teaching according to their strategy. Later, the observers and the facilitators (in treatment group 1) were separated and trained respectively in order to be able to carry out their functions effectively during the study. The training lasted one week. After the training, the treatment commenced in each treatment group and lasted for eight weeks. The two treatment groups were: reflective focus group discussion strategy and reflective peer observation strategy. The third group was control group. After the treatment in each treatment group, the posttest commenced with the observation of the sampled SS II biology teachers by the research assistants (i.e trained observers) using TCPOS to score the teachers' selected teaching variables in the study. One TCPOS was used per lesson per teacher.

The presentation procedure for reflective teaching adapted from Florez (2001) Pacheco (2005) and Farrell (2009) was used in the study and presented as follows:

- Step I: Administration of Biology Teachers' Reflective Teaching Knowledge Test (BTRTKT) to all sampled biology teachers in the selected schools.
- Step II: Administration of SATB to biology students in all sampled the selected schools.
- Step III: Training of observers for pretreatment classroom practice observation of biology teachers.
- Step IV: Observation and scoring of classroom practice of all the sampled biology teachers using TCPOS.
- Step V: Random assignment of the selected schools into treatment and control groups.
- Step VI: Introduction of treatment into the schools in each of the experimental group.
- Step VII: Selection and training of teachers, facilitators and presentation of instructional guides and concepts to be taught to participants in each school by the researcher.
- Step VII Application of treatment to the treatment groups.
- Step IX: Recording of mid-treatment data of biology teachers' classroom practice scores in the fifth and sixth week of the introduction of the treatment by the observers and the immediate collection by the researcher.
- Step X: Observation and scoring of SS II biology teachers after the treatment by the observers using TCPOS and administration of BTRTKT to biology teachers and achievement test (SATB) to the biology students in each school in the treatment groups and control group. (i.e. post-treatment)

Step XII: The researcher visits the schools for collection of post-treatment data.

Step XIII: Collation of data by the researcher.

Table 3.3: The time frame for the study is indicated in the table below.

Week	Activities
One	Selection of eligible schools, Permission from the school authorities and random assignment of schools in to experimental and control groups.
Two	Training of research assistants (i.e observers) with TCPOS by the researcher.
Three- Four	Pre treatment administration by the researcher and research assistants with BTRTKT, SATB, TCPOS
Five	Training of participating teachers, facilitators and re-training of observers for treatments 1 and 2. Presentation of concept and topics to be taught to biology teachers.
Six-Thirteen	Application of treatment in Experimental Groups 1 and 2. Collection of mid treatment data of biology teachers' classroom practice scores in the tenth week.
Fourteen-Fifteen	Post treatment administration by the researcher and research assistants with BTRTKT, SATB and TCPOS.
Sixteen	Collection of posttest data from the research assistant and Collation of all data.

The implementation procedure carried out for the treatment and control groups are as follows:

3.7 Procedure for Training Observers

1. The researcher invited more than the required number of research assistants for the training. This is to have opportunity to select most qualified number to participate in the study.

2. Each research assistant is expected to possess a minimum qualification of National Certificate of Education (NCE) to qualify to participate in the training.
3. Ensures that all the invited research assistants (i.e prospective observers) are present at the training venue before the commencement of the training.
4. The observers were trained by the researcher using Teacher's Classroom Practice Observational Scale (TCPOS)
5. The researcher read out each item in the observational scale and explained it.
6. Read out the procedure for scoring each item in the guide along with the items and explained how the scoring would be carried out.
7. At the end of the explanation of each item in the guide the researcher showed a videotaped lesson for them to observe and use the observation scale and score the teacher in the classroom in the video using the guide to ensure the training was effective.
8. At the end of the explanations of all the items in the scale and use of videotaped lesson for scoring, the researcher asked if the trainees have questions on any part of the observational scale.
9. The researcher answered their questions and later asked the participants questions to ensure the instrument was clear to them.
10. Each participant was asked to read out and explain each item on the observation scale and how the scoring would be carried out using the observation scale.
11. Another recorded videotaped classroom lesson was shown to each participant to observe and score the teacher in order to ensure the training was effective. The researcher carefully examined how this was carried out by each participant.
12. The researcher used the checklist in part two to select the observer for each school.

3.8 Procedure for Training of Teachers

- (i) The researcher met the science teachers in each school.
- (ii) The reflective focus groups were constituted in treatment group 1 schools.
- (iii) The sampled biology teachers only were separated for the reflective activities in treatment group 2 schools.

- (iv) The research assistants were introduced to the teachers as observers. It was stressed that the observers would always be present with the teachers during reflection.
- (v) The meaning of reflective teaching practice was explained to the teachers in the treatment groups.
- (vi) The researcher explained the process of the treatment in sequential order to the participating teachers in each treatment group according to the strategy of each group using the appropriate guide - TIGRFGD for treatment group 1 and TIGRPO for treatment group 2.
- (vii) The teachers were given the guides as handouts while the researcher reads out each of the items in the guides and explained to the teachers. During the training, the researcher made use of reflective activities on a sampled topic to make the training clearer and effective.
- (viii) Thereafter, teachers were allowed to ask questions and were asked questions by the researcher.
- (ix) In treatment group 1 the head of science department and the assistant were demanded for and informed that one of them will act as the facilitator who will coordinate each reflective discussion meeting.
- (x) After the general training of all the teachers, the facilitators were separated and trained again using the instruments – TIGRFGD and IGF in treatment group 1.
- (xi) As part of the training, the researcher asked each participant to make presentations and the more qualified participants were chosen as the facilitators.
- (xii) All the observers were also separately trained again using the following instruments- IGO, TCPOS.
- (xiii) As part of the training, the researcher asked each participant to make presentations and the more qualified participants were chosen.

Treatment Group 1: Reflective Focus Group Discussion Strategy.

Step 1: Constitution of Reflective Focus Group which is made up of six science teachers (1 chemistry, 1 physics, 1 mathematics, 1 agricultural science and two biology teachers)

and selection of head of science department as the facilitator who coordinated the reflective activities before and after teaching by the researcher.

Step 2: The group met for reflection before teaching for one hour in the biology laboratory at the scheduled time at the beginning of each week before the biology teachers started teaching for the week.

Step 3: The facilitator initiated and led the reflective discussion with probing questions and answers, considered and analysed the teaching actions related to intended learning and how learning would be accomplished using part one of the guide-TIGRFGD

Step 4: Every member of the group participated in the reflective discussion and the facilitator led the group to reach conclusion on each item about teaching in the guide.

Step 5: The biology teachers took note of each conclusion during reflection before teaching and prepared their lesson notes based on the outcomes of reflection before teaching.

Step 6: The observer who was present during the reflective discussion went to classes to observe and score the two biology teachers while teaching using TCPOS.

Step 7: The Reflective Focus Group convened again for one hour in the biology laboratory at the scheduled time at the end of the week after the biology teachers' classroom teachings.

Step 8: The facilitator led the reflective discussion using part two of the instrument-TIGRFGD.

Step 9: Each of the biology teachers reported how his or her class was taught based on reflection before teaching.

Step 10: The group reflected on the reports given by the two biology teachers following part two of the guide – TIGRFGD.

Step 11: They reached a conclusion on how the classroom activities could be made better for subsequent teaching.

Step 12: The group convened again for reflection before and after teaching which was done repeatedly for eight weeks of the treatment during which the group met sixteen times. Each of the two biology teachers was observed twelve times while teaching.

Treatment Group 2: Reflective Peer Observation Strategy.

Step 1: Identification of biology teachers as teaching peers.

Step 2: The two SS II biology teachers met for one hour in the biology laboratory at the scheduled time at the beginning of the week for reflection before teaching. The observer was also present.

Step 3: Each of the two biology teachers contributed in the reflective activities with probing questions and answers which considered and analysed teaching actions related to intended learning and how learning would be accomplished by the biology teachers using part one of the instrument-TIGRPO.

Step 4: The two biology teachers reached a conclusion on each item in the instrument.

Step 5: Each of the two biology teachers prepared lesson note based on the concluded reflection before teaching.

Step 6: The biology teachers taught in their different classes using the prepared lesson notes/plans.

Step 7: The biology teachers took turns to observe each other while teaching, based on reflection before teaching. Each take note of what happened in partner's classroom.

Step 8: The observer who was also present during the reflection by the teachers before teaching observed and scored the teachers while teaching using TCPOS.

Step 9: The two teachers met again for an hour in the biology laboratory after classroom teachings for reflection after teaching at the scheduled time using part two of the guide-TIGRPO. Each teacher described the activities observed in the partner's classroom based on reflection before teaching.

Step 10: The report of each teacher was systematically considered, analysed and evaluated by the two biology teachers following the activities in part two of the instrument.

Step 11: The teachers concluded on how the activities could be better carried out at subsequent teaching.

Step 12: The two SS II biology teachers convened again for reflection before and after teaching. This was done repeatedly for eight weeks of the treatment. During this time the teachers met sixteen times and observed each other twelve times.

Procedure for Conventional Method: Control Group

- Step 1:** The SS II biology teachers in the schools were presented with the selected topics to be taught under ecology.
- Step 2:** Each of the teachers gathered materials for their teaching on their own.
- Step 3:** Preparation of lesson notes by each of the biology teachers.
- Step 4:** The teachers taught in their respective classrooms using their prepared lesson notes.
- Step 5:** The observers observed and scored the biology teachers while teaching in classroom.
- Step 6:** The teachers prepared lesson note for the next teaching. This was continued for eight weeks. Each teacher was observed twelve times by an observer while teaching.

3.9 Data Analysis.

The data collected from this study were analysed using descriptive statistics (mean, standard deviation) as well as inferential statistics of Analysis of Covariance (ANCOVA) which was used to determine the significant main and interaction effects of the variables of the study. Multiple Classification Analysis (MCA) was used to determine the magnitude of performance of each group. Scheffe Post-hoc analysis was employed to trace the source of the observed significant difference among the groups. All hypotheses were tested at $p < 0.05$ level of significance. Graphs were also used to analyse the data collected.

CHAPTER FOUR

RESULTS

This chapter contains a detailed description of the findings in the study. The results obtained in this study are presented and discussed below. The sequence of presentation follows the research questions asked and hypotheses formulated for the study.

4.1: Answers to the Research Questions

Research Question One: What are the pre and post-treatment observation scores of teachers' classroom practices based on:

- Treatment Groups- reflective focus group, reflective peer observation and conventional method.
- Level of teachers' knowledge of reflective teaching.
- Teachers' Gender?

Table 4.1: Mean and Standard Deviation of Pre and Post treatment Scores of Biology Teachers' Classroom Practice by Treatment groups, Teachers' Knowledge and Gender.

Variable	Category	PREOBS	POSTOBS	Mean Gain
Treatment	Reflective Focus Group Discussion strategy (N=6)	31.3 (3.1)	83.0 (1.0)	51.7
	Reflective Peer Observation strategy (N=6)	32.4 (1.7)	76.7 (7.8)	44.3
	Conventional Method (N=6)	32.9 (2.1)	32.2 (1.6)	- 0.7
Teachers' Knowledge	Low (N=11)	31.5 (1.9)	63.3 (25.5)	31.8
	High (N=7)	33.5 (2.7)	65.0 (22.7)	31.5
Teachers' Gender	Male (N=8)	31.8(2.4)	67.2 (21.1)	35.4
	Female (N=10)	32.6(2.5)	61.4 (26.3)	28.8

- (a) Table 4.1 reveals that the pre treatment observation mean scores of teachers' classroom practice obtained by biology teachers in the treatment groups were, Reflective Focus Group Discussion = 31.3; Reflective Peer Observation = 32.4 while post treatment scores were, Reflective Focus Group Discussion = 83.0; Reflective Peer Observation = 76.7. Biology teachers in Reflective Focus Group Discussion Strategy obtained a mean gain of 51.7 while their counterparts in Reflective Peer Observation Strategy showed a mean gain of 44.3 in classroom observation. The teachers in the Conventional Method which is the control group recorded a reduction in teachers' classroom practice observation scores from 32.9 in the pre-treatment observation to 32.2 in post treatment observation. Therefore, the result shows an improvement of post treatment classroom practices scores of biology teachers over the pre treatment classroom practice scores in the treatment strategies.
- (b) Table 4.1 shows that teachers with a low level of reflective teaching knowledge recorded a pre treatment score of 31.5 and a post treatment score of 63.3 with a corresponding score gain of 31.8 while teachers with a high level of reflective knowledge had a pre treatment score of 33.5 and a post treatment score of 65.0 with a mean gain of 31.5. This shows an increase in biology teachers' knowledge of reflective teaching after exposure to treatment. The increase being slightly more for teachers with low level reflective teaching knowledge compared with those with higher level.
- (c) In table 4.1, male teachers were revealed to have pre treatment classroom practice observation mean score of 31.8 and post treatment classroom practice observation mean score of 67.2 with a mean gain of 35.4. The table also shows that female teachers have pre treatment classroom practice observation mean score of 32.6 and the post treatment score of 61.4. This shows that there was increase in the classroom practices of teachers, but with the male teachers recording a higher increase in classroom practice than female teachers.

Research Question Two: What are the pre and post treatment achievement scores of students in Biology based on:

- (a) Treatment groups - reflective focus group, reflective peer observation and conventional method.
- (b) Level of teachers' knowledge of reflective teaching.
- (c) Teachers' gender?

Table 4.2: Means and Standard Deviation of Pre and Post treatment Achievement Scores of Students in Biology by Treatment Groups, Teachers' Knowledge and Gender.

Variable	Category	PRE	POST	Mean Gain
	Reflective Focus Group Discussion strategy (N=174)	9.4 (3.0)	15.3(2.8)	5.9
	Reflective Peer Observation strategy (N=210)	8.9 (2.5)	12.4 (2.4)	3.5
	Conventional Method (N=192)	6.6 (2.3)	8.6 (2.5)	2.0
Teachers' Knowledge	Low (N=360)	8.2 (2.8)	11.9 (3.8)	3.7
	High (N=216)	8.6 (2.9)	12.2 (3.6)	3.6
Teachers' Gender	Male (N=240)	8.1 (2.3)	12.0 (3.1)	3.9
	Female (N=336)	8.5 (3.1)	12.0 (4.1)	3.5

(a) Table 4.2 reveals the pre treatment and posttreatment achievement mean scores of students in biology in all the strategies. The differences indicated in the table in students' achievement mean scores in biology with Reflective Focus Group Discussion Strategy obtaining the highest mean gain of $\bar{x} = 5.9$, followed by Reflective Peer Observation strategy with mean gain of $\bar{x} = 3.5$ and Conventional Method with mean gain of $\bar{x} = 2.0$. This shows an increase in the achievement of students in biology after the treatment.

(b) Table 4.2 also shows students' pre treatment and posttreatment achievement mean scores with respect to teachers' knowledge of reflective teaching. The pretreatment scores shows that the students in the category of teachers with low knowledge of reflective teaching had a pretreatment mean score of 8.2 and posttreatment mean score of 11.9 (with mean gain of 3.7). While the students in the category of teachers with high knowledge of reflective teaching had a mean score of 8.6 for the pretreatment and 12.2 for posttreatment (with mean gain of 3.6). This shows a slight increase in the achievement of students in biology after the treatment with respect to teacher's knowledge of reflective teaching.

(c) The pre treatment achievement mean score of students with male teachers is 8.1 while the posttreatment mean score is 12.0. Therefore, the mean gain in the achievement scores is 3.9. The pretest and posttest achievement mean scores of students with female teachers were 8.5 and 12.0 respectively. The mean gain is therefore 3.5. This shows a slight increase in the achievement mean score of students of male teachers over their counterparts with female teachers.

Research Question Three: What are the pre, mid and post treatment classroom practice scores of biology teachers?

Table 4.3: Mean Scores of Pre, Mid and Post treatment Observation Scores of Biology Teachers' Classroom Practices

Treatment	Pretest	Mid treatment	Posttest
RFGD	31.3	74.4	83.0
RPO	32.4	63.2	76.7
CONV	32.9	26.9	32.2

Table 4.3 revealed gradual increase in the classroom practice of biology teachers in the treatment groups. Reflective focus group discussion strategy had mean scores of $\bar{x} = 31.3, 74.4$ and 83.0 for pretest, mid treatment and posttest respectively. While reflective peer observation strategy had mean scores of $\bar{x} = 32.4, 63.2$ and 76.7 for pre, mid and post treatment respectively. In the conventional method (control group) there is an initial decline in biology teachers' classroom practice scores and later, an increase with mean scores of $\bar{x} = 32.9, 26.9$ and 32.2 for pre, mid and posttreatment scores respectively. The

RFGD strategy brought about the highest improvement of biology teachers' classroom practices. This is closely followed by reflective peer observation strategy while the control group trailed behind. This is further represented in figure 1 below.

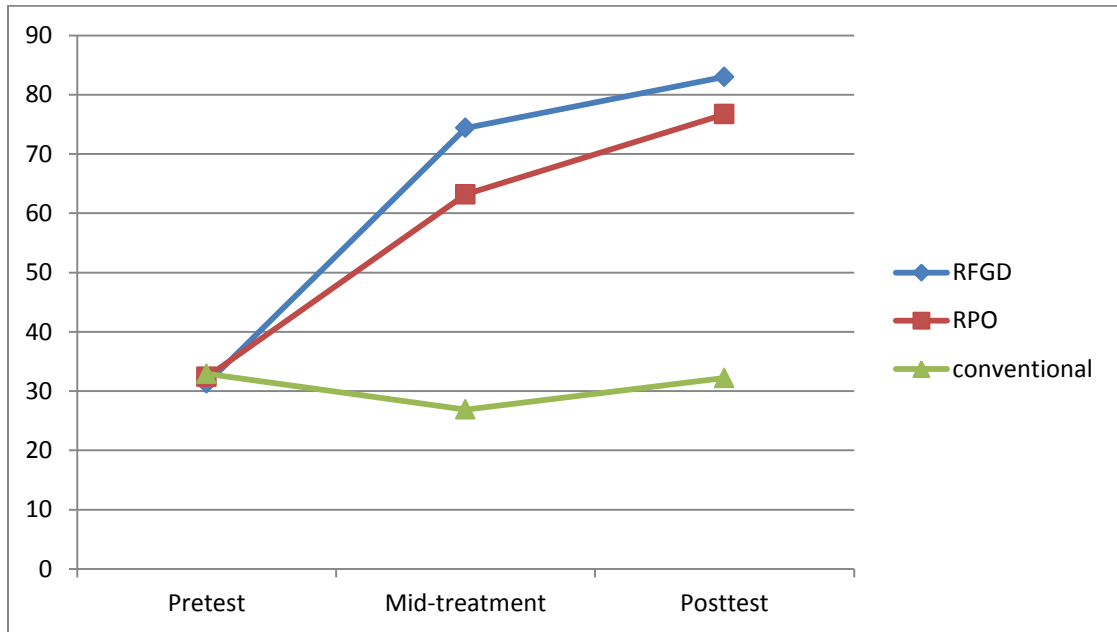


Figure 4.1: Differences between the pre, mid and post treatment observation of biology teachers' classroom practice in the two treatment and control group.

4.2: Testing of Hypotheses

HO 1a: There is no significant main effect of treatment on teachers' classroom practice. To test this hypothesis, Table 4.4 on the ANCOVA results is presented

Table 4.4: Summary of ANCOVA of Posttreatment of Teachers' Classroom Practice by Treatment, Knowledge and Gender

Source of Variance		Hierarchical Method					
		Sum of squares	df	Mean Square	F	Sig.	
Covariates	PREOBS	314.6	1	314.6	10.5	.02	
	MainEffects (Combined)	8955.2	4	2238.8	74.4	.00	
2-Way (Combined)	TREATMT	8921.9	2	4460.9	148.3	.00*	
	KNOWLEV	32.9	1	32.9	1.1	.34	
	GENDER	.3	1	.3	.0	.93	
	interactions	75.3	5	15.1	.5	.77	
	TREATMT x KNOWLEV	8.9	2	4.5	.1	.87	
	TREATMT x GENDER	58.9	2	29.4	.9	.44	
	KNOWLEV x GENDER	.1	1	.1	.0	.95	
	3-Way Interaction	TREATMT x KNOWLEV x GENDER	33.2	2	16.6	.6	.61
	Model		9378.3	12	781.5	25.9	.00
	Residual		150.4	5	30.1		
Total		9528.7	17	560.5			

* Significant at $p < .05$

Table 4.4 shows that there is significant effect of treatment on biology teachers' classroom practices ($F_{(2,17)}=148.3; p < .05$). This means that biology teachers exposed to the reflective focus group discussion, those in reflective peer observation and those in the control group had significantly different adjusted mean scores. To this end, hypothesis 1a is rejected.

To find out the relative performance of a treatment group relative to the others, Table 4.5 is presented.

Table 4.5: Multiple Classification Analysis (MCA) of Posttreatment Classroom Practices by Treatment, Knowledge and Gender

Grand Mean = 63.9

Variable + Category	N	Predicted Mean		Deviation		Eta	Beta
		Unadjusted	Adjusted for factors and covariates	Unadjusted	Adjusted for factors and covariates		
Ref Focus Gp Discussion	6	83.0	83.7	19.0	19.8	.9	1.0
Ref Peer Obs	6	76.7	76.9	12.7	12.9		
Conv Mtd	6	32.2	31.3	-31.8	-32.7		
KNOWLED Low	11	63.3	65.1	-.7	1.2	.0	.1
High	7	65.0	62.1	1.1	-1.9		
GENDER Male	8	67.2	63.8	3.2	-.1	.1	0
Female	10	61.4	64.1	-2.6	.1		
R = .9							
R Squared = .9							

From Table 4.5, biology teachers in the reflective focus group discussion strategy obtained the highest adjusted classroom practice mean score ($\bar{x} = 83.7$; Adj.Dev=19.8) than the teachers exposed to the reflective peer observation strategy ($\bar{x} = 76.9$; Adj.Dev=12.9) while, the control group obtained the lowest mean score in classroom practices ($\bar{x} = 31.3$; Adj. Dev = -32.7). This implies that reflective focus group discussion strategy was most effective in improving teachers' classroom practices in biology than the reflective peer observation strategy and conventional method.

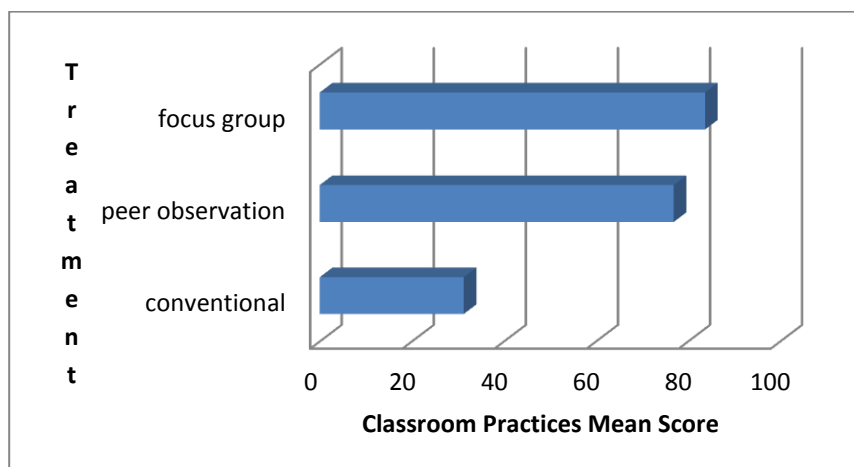


Figure 4.2: Adjusted Posttest Classroom Practice for Biology Teachers Across Reflective Strategies.

Figure 4.2 further illuminates the relative status of each of the three strategies of reflective teaching based on biology teachers' classroom practices. The reflective focus group discussion strategy had the highest mean score of 83.7. This was closely followed by reflective peer observation strategy with a mean score of 76.9 while the conventional method came distant third with the mean of 31.3.

In order to trace the actual source of the significant effect of treatment on classroom practices, Table 4.6 on Scheffé pairwise comparison was presented.

Table 4.6: Scheffe Post hoc Tests of Teachers' Classroom Practices by Treatment

Treatment	N.	\bar{x}	Treatment		
			Ref Focus Grp Disc	Ref Peer obs	Conv. Lect
Ref Focus Grp Disc	6	83.7			*
Ref Peer Obs	6	76.9			*
Conv Mtd	6	31.3	*	*	

* Pairs Significantly different at $p < .05$

Table 4.6 shows that the reflective focus group discussion strategy ($\bar{x} = 83.7$) was significantly different from the conventional method ($\bar{x} = 31.3$) and the reflective peer observation strategy was significantly different from the conventional method group ($\bar{x} = 31.3$). These two pairs therefore contributed to the observed significant effect of treatment on classroom practice. However, the two experimental treatment groups i.e reflective focus group discussion and reflective peer observation were not significantly different from each other and so did not contribute to the significant effect of treatment on classroom practice.

HO 1b: There is no significant main effect of treatment on students' achievement in biology.

Table 4.7 Summary of ANCOVA of Posttreatment Students' Achievement Scores by Treatment, Teachers' knowledge and Teachers' Gender

Source of Variance		Hierarchical Method				
		Sum of squares	df	Mean Square	F	Sig.
Covariates	PRE	2487.0	1	2487.0	459.7	.00
Main Effects	(Combined)	2378.4	4	594.6	109.9	.00
	TREATMT	2364.2	2	1182.1	218.5	.00*
	TRKNOWL	0.061	1	0.061	.0	.92
	TRGENDER	14.2	1	14.2	2.6	.11
2-Way interactions	(Combined)	76.4	5	15.3	2.8	.02
	TREATMT					
	x	6.1	2	3.1	.6	.57
	TRKNOWL					
	TREATMT					
	x	58.2	2	29.1	5.4	.01*
	TR GENDER					
	TRKNOWL					
	x	16.8	1	16.8	3.1	.08
	TR GENDER					
3-Way Interaction	TREATMT					
	x					
	TRKNOWL	32.3	2	16.2	2.9	.05
	x					
	TR GENDER					
Model		4974.2	12	414.5	76.6	.00
Residual		3045.7		5.4		
Total		8019.9	563	13.9		
			575			

* Significant at $P < .05$

Table 4.7 shows that there is a significant effect of treatment on students' achievement in biology ($F_{(2,575)}=218.5$; $p < .05$). This implies that there is significant difference in adjusted posttreatment achievement scores of biology students exposed to reflective focus group discussion, reflective peer observation and conventional method. Hence, hypothesis 1b is rejected. To find the magnitude of performance of each group, table 4.8 is presented.

Table 4.8: Multiple Classification Analysis (MCA) of Students' Achievement in Biology by Treatment, Teachers' Knowledge and Gender

Grand Mean = 12.0

Variable + Category	N	Predicted Mean		Deviation		Eta	Beta
		Unadjusted	Adjusted for factors and covariates	Unadjusted	Adjusted for factors and covariates		
Ref Focus Grp Discussion.	174	15.3	14.8	3.3	2.8	.7	.6
Ref Peer Obs	210	12.4	12.2	.4	.2		
Conv Mtd	192	8.6	9.3	-3.4	-2.7		
TRKNOWL low	360	11.9	12.0	-.09	.03	.0	.0
High	216	12.2	11.9	.2	-.05		
GENDER Male	240	12.0	12.2	.02	.2	.0	.0
Female	336	12.0	11.9	-.01	-.1		
R = .8							
R Squared = .6							

From Table 4.8 students exposed to reflective focus Group discussion teachers obtained highest adjusted mean achievement scores ($\bar{x} = 14.8$; Adj.Dev = 2.8), compared to those in reflective peer observation ($\bar{x} = 12.2$; Adj. Dev = .2) and the conventional method ($\bar{x} = 9.3$; Adj. Dev = -2.7) respectively. Thus, reflective focus group discussion strategy was the most effective in improving students' achievement in biology compared to reflective peer observation strategy and the conventional method. Figure 4.3 amplifies this finding.

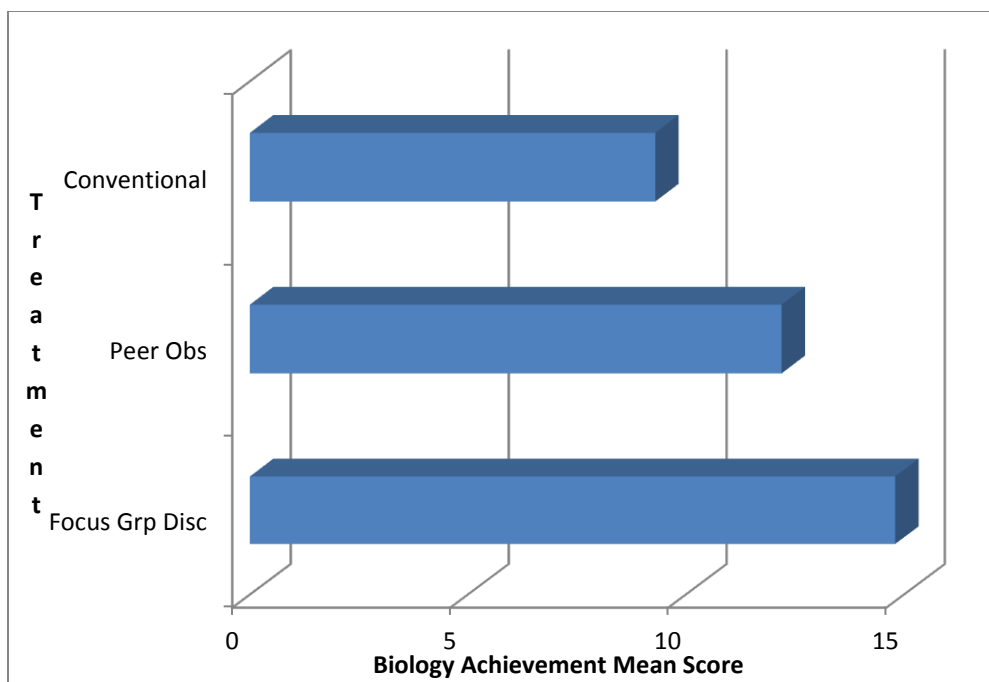


Figure 4.3: Relative Effectiveness of the Treatment Groups on Students' Achievement in Biology.

Figure 4.3 shows that the reflective focus group discussion strategy was ahead of the other groups with the mean score of 14.8. It is closely followed by reflective peer observation strategy (mean score = 12.2) while the conventional method trailed behind with mean score of 9.3). The source of the significant effect of treatment on students' achievement was traced with the help of Scheffé post hoc test.

Table 4.9: Scheffe Post hoc Tests of Students' Achievement by Treatment

Treatment	N.	\bar{x}	Treatment		
			Focus Grp Disc	Peer obs	Trad. Lect
Focus Grp Disc	174	14.8		*	*
Peer Obs	210	12.2	*		*
Conv Mtd.	192	9.3	*	*	

* Pairs of groups significantly different at $p < .05$

From Table 4.9, the reflective focus group discussion strategy and the reflective peer observation strategy were significantly different from one another. Also, the focus group discussion strategy was significantly different from the conventional method while the reflective peer observation strategy was also significantly different from conventional method. This shows that students in each of the groups differed significantly in their achievement in biology.

HO 2a: There is no significant main effect of teachers' reflective teaching knowledge on teachers' classroom practices.

From Table 4.4, teachers' knowledge of reflective teaching has no significant effect on classroom practices of teachers ($F_{(1,17)} = 1.1$; $p < .05$). Hence, hypothesis 2a is not rejected. Table 4.5 further shows that biology teachers with low level of knowledge obtained higher classroom practices ($\bar{x} = 65.1$; Adj.Dev = 1.2) than their peers with high level of knowledge ($\bar{x} = 62.1$; Adj.Dev = -1.9). This difference is, however not significant.

HO 2b: There is no significant main effect of teachers' reflective teaching knowledge on students' achievement in biology.

Table 4.7 shows that there is no significant effect of teachers' level of knowledge of reflective teaching on students' achievement in biology ($F_{(1,575)} = .0$; $p > .05$). On this basis, hypothesis 2b is not rejected. From Table 4.8, teachers with low level of knowledge produced students with slightly higher achievement in biology ($\bar{x} = 12.0$; Adj.Dev = -.09) compared to the students taught by teachers with high level of knowledge ($\bar{x} = 11.9$; Adj.Dev = -.05). However, the difference was not significant.

HO 3a: There is no significant main effect of teachers' gender on classroom practice.

Table 4.5 shows that teachers' gender has no significant effect on teachers' classroom practices ($F_{(1,17)} = .0$; $p > .05$). Therefore hypothesis 3a is not rejected. From Table 4.7, it was obtained that female teachers had slightly higher classroom practice score ($\bar{x} = 64.1$; Adj.Dev = .1) than their male counterparts ($\bar{x} = 63.8$; Adj.Dev = -.1). But, it was not significant.

HO 3b: There is no significant main effect of teachers' gender on students' achievement in biology.

From Table 4.7, teachers' gender has no significant main effect on biology students' achievement ($F_{(1,575)} = 2.6$; $p > .05$). Hence hypothesis 3b is not rejected. Further, Table 4.8 reveals that the students taught by male teachers had slightly higher mean biology achievement score ($\bar{x} = 12.2$; $\text{Adj.Dev.} = .2$) than students taught by their female counterparts ($\bar{x} = 11.9$; $\text{Adj.Dev.} = -.1$). But it was not significant.

HO 4a: There is no significant interaction effect of treatment and reflective teaching knowledge on teachers' classroom practices.

Table 4.4 shows that the interaction effect of treatment and teachers' knowledge on teachers' classroom practices is not significant ($F_{(2,17)} = .1$; $p > .05$). Hence, hypothesis 4a is not rejected

HO 4b: There is no significant interaction effect of treatment and teachers' reflective teaching knowledge on students' achievement in biology.

From Table 4.7, there is no significant interaction effect of treatment and teachers' knowledge on students' achievement in biology ($F_{(2,575)} = .6$; $p > .05$). On this basis, hypothesis 4b is not rejected.

HO 5a: There is no significant interaction effect of treatment and teachers' gender on classroom practices.

Table 4.4 shows that the interaction effect of treatment and teachers' gender on biology teachers' classroom practices is not significant ($F_{(2,17)} = .9$; $p > .05$). Hypothesis 5a is therefore not rejected.

HO 5b: There is no significant interaction effect of treatment and teachers' gender on students' achievement in biology.

From Table 4.6, there is a significant interaction effect of treatment and teachers' gender on students' achievement in biology ($F_{(2,575)} = 5.4$; $p < .05$). Hypothesis 5b is therefore rejected. This significant interaction effect is explained on figure 4.4

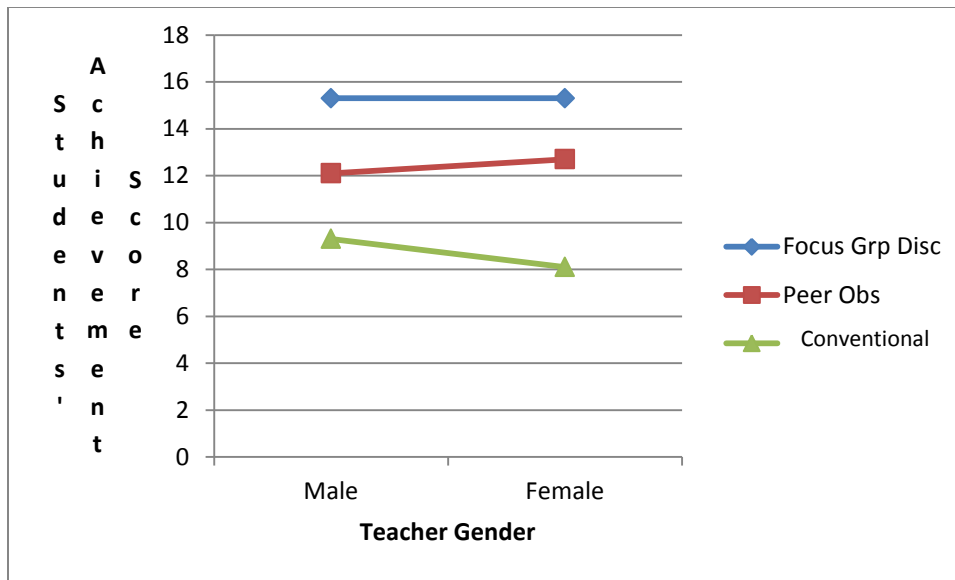


Figure 4.4: Interaction of Treatment and Teachers' Gender on Students' Achievement in Biology.

Figure 4.4 shows that reflective focus group discussion is the most effective strategy for male biology teachers as well as for their female counterparts. For both gender groups, the reflective peer observation came second while the conventional method was the least effective across the gender grouping. This is an ordinal interaction implying that treatment is not gender biased. The treatment benefited both gender.

HO 6a: There is no significant interaction effect of teachers' reflective teaching knowledge and gender on classroom practices.

Table 4.4 shows that teachers' reflective teaching knowledge and teachers' gender had no significant effect on biology teachers' classroom practices ($F_{(1,17)} = .0$; $p > .05$). Hence, hypothesis 6a is not rejected.

HO 6b: There is no significant interaction effect of teachers' reflective teaching knowledge and gender on students' achievement in biology.

From Table 4.7, there is no significant interaction effect of teachers' reflective teaching knowledge and gender on students' achievement in biology ($F_{(1,575)} = 3.1$; $p > .05$). Hypothesis 6b is therefore not rejected.

HO 7a: There is no significant interaction effect of treatment, teachers' reflective teaching knowledge and teachers' gender on classroom practices.

Table 4.4 shows that the 3-way interaction effect of treatment, teachers' reflective teaching knowledge and teachers' gender on Biology teachers' classroom practices is not significant ($F_{(1,17)} = .6$; $p > .05$). Therefore, hypothesis 7a is not rejected.

HO 7b: There is no significant interaction effect of treatment, teachers' reflective teaching knowledge and teachers' gender on students' achievement in Biology.

From Table 4.7, there is no significant 3-way interaction effect of treatment, teachers' reflective teaching knowledge and teachers' gender on students' achievement in biology ($F_{(1,575)} = 2.9$; $p > .05$). Hypothesis 7b, is therefore, not rejected.

4.3. Summary of Findings

The findings of the study revealed the following:

- 1) There was a significant effect of the treatment on biology teachers' classroom practices and students' achievement. The reflective focus group discussion strategy was the most effective followed by the reflective peer observation strategy while the conventional method was the least.
- 2) The reflective teaching knowledge of teachers had no significant effect on teachers' classroom practices and students' achievement in biology.
- 3) Teachers' gender had no significant effect on teachers' classroom practices and students' achievement in biology.
- 4) There was no significant interaction effect of treatment and reflective teaching knowledge on teachers' classroom practices and students' achievement in biology.
- 5) There was no significant interaction effect of treatment and teachers' gender on teachers' classroom practices. But there was a significant interaction effect of treatment and teachers' gender on students' achievement in biology.
- 6) The interaction effect of teachers' reflective teaching knowledge and gender on teachers' classroom practices and students' achievement in biology was not significant.

- 7) The 3-way interaction effect of treatment, teachers' reflective teaching knowledge and teachers' gender on teachers' classroom practices and students' achievement in biology were not significant.

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CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATIONS

This chapter presents the discussion of results, conclusion and recommendations made based on the findings of the study.

This study investigated the effects of two reflective teaching strategies on secondary school teachers' classroom practices and students' achievement in biology. The study also determined the effect of teachers' gender and reflective teaching knowledge on teachers' classroom practices and students' achievement. In this chapter, findings from the results of the study are discussed; conclusion drawn and recommendations are made based on the findings of the study. Three research questions raised were answered and seven hypotheses generated were tested at 0.05 level of significance.

5.1 Discussion

5.1.1 Effects of Treatment on Teachers' Classroom Practices and Students' Achievement in Biology

The findings of the study revealed that the two treatment groups significantly affected biology teachers' classroom practices. The reflective focus group discussion experimental group obtained the highest adjusted mean score followed by the reflective peer observation experimental group with least performance recorded in the conventional group. The introduction of treatment in the two experimental groups could have been responsible for the performance of teachers. Both reflective focus group discussion and reflective peer observation strategies involve teachers carrying out systematic and critical consideration, analysis and assessment of their classroom practices such as communication style, use of instructional materials, questioning and time management before and after teaching in pairs or groups. When such teachers came together for systematic process of reflective teaching, they were able to generate ideas about classroom teaching which complemented each others' limitations which must have assisted in improving teachers' classroom practices.

The advantage which reflective focus group discussion experimental group had over the reflective peer observation may be due to the involvement of more teachers in the critical and systematic consideration, analysis and assessment of their communication style, use of instructional materials, questioning and time management during reflective activities before and after teaching. In reflective peer observation strategy only two teachers were involved in consideration and evaluation of classroom practice before and after teaching in reflective practice. During reflective activities in reflective focus group discussion experimental group, more teachers were involved in deep critical thinking, consideration, analysis and evaluation of biology teachers' classroom teaching. The fact of having more teachers in the RFGD strategy might have given rise to generation of various ideas on classroom practices. This would be an advantage over the reflective peer observation strategy in which only two teachers brainstormed during reflection. This might have led to the level of improvement in classroom practices of the teachers in each case. The more improvement of teachers in RFGD supports the submission of Ferraro (2000), Farrell (2010) that groups of teachers reflecting together can generate various ideas about classroom issues which would lead to improvement and better performance of teachers in classroom.

Another advantage of reflective focus group discussion experimental group may also be that the biology teachers in the group were open in reporting their classroom practices during reflection without feeling the need to hide their opinions. This according to Ferraro (2000) would have assisted the group to compliment the teachers' strength and compensate their weaknesses thereby challenging the teachers' existing theories and preconceived views of teaching that improved classroom practices. This finding is also in agreement with Minott (2009) that collaborative reflective processes with colleagues' reinforce teachers' knowledge and practices about teaching.

The reflective peer observation experimental group also recorded an increase in teachers' classroom practices but not much as the reflective focus group discussion experimental group. This may be due to the number of teachers who participated in the reflective activities. Since only two teachers were involved in the reflective process, therefore, limited ideas would have been generated during the critical thinking, consideration, analysis and evaluation process of reflection. The limited ideas generated

would have been available for reflection on communication styles of the teachers. The suggestions and ideas generated during reflection to make communication style of the teachers better in their classrooms were limited, hence the changes and improvement observed in the biology teachers classroom practices would have been based on the available ideas. This is also true for other variables of the classroom practice considered in this the study. The suggestion of ideas for changes and better improvement through critical consideration, assessment and analysis on teachers' communication style, the use of instructional materials, questioning and time management would have been limited to only two participating teachers of the strategy. This corroborates Farrell (2009) submission that two teachers engaging in reflective activities may not be able to achieve outcomes that a group of teachers reflecting together can achieve. The performance in the reflective peer observation group may also be due to insufficient observations of the teachers. It may be that only few aspects of the partners' classroom teaching were observed for reflective activities. Therefore, the unobserved aspect of the teachers' classroom practice remained dominant and unreflected upon during reflective activities. This supports Holmes (2005) assertion that a single idea no matter how good may not effect changes as a multiple of ideas from many observers. The findings of the study may also be that the teachers in the RFGD strategy were able to apply more reflective activities to their classroom practices than teachers in the RPO strategy.

The conventional method group had the least performance of teachers' classroom practices. This group was not exposed to reflective activities which took place in this study. The teachers carried out their normal conventional classroom practices. In this group, each biology teacher did the teaching in a personal way without reflection. No treatment was introduced with the view of changing their practices. Since no critical thinking, consideration, analysis and evaluation of communication style, use of instructional materials, questioning and time management took place as a result of reflection, ideas and suggestions for improvement on classroom practice were not available therefore, teachers' performance in classroom were very low. This supports Ajitoni's (2008) assertion of the need for teachers to move from routine response to teaching to improve classroom practice.

The revelation of result that the two experimental groups produced tremendous positive impact on teachers' classroom practices is in agreement with the submission of Ferraro (2000), Pacheco (2005), Farrell (2010) and Atherton (2013) that the use of reflective practice in teaching is based on the belief that teachers can improve their own teaching by continuously and systematically reflecting on their experiences. Through the process of reflection which involves planning, observing, analysing, evaluating, acting and reviewing, teachers can learn a great deal about the nature of classroom teaching and learning. Therefore, they continually reshape their knowledge and students' learning. The teachers are thereby moved from a level of been guided largely by impulse, intuition or routine to a level where actions are guided by critical thinking in reflection.

Furthermore, the findings also showed that the treatment in the two experimental groups significantly affected biology students' achievement. The significant effects of the treatment groups on students' achievement may be due to the reflective activities carried out by the teachers in these groups. Through reflection, teachers can consider, examine and evaluate their teaching to make changes in order to improve attitudes, beliefs and teaching practices which lead to better students' performance and achievement. This implies that the biology teachers in the experimental groups were able to communicate better thus making the subject easier and interesting, utilize instructional materials in better ways that granted more understanding and learning to students, rendered better style of questioning and are able to manage their time effectively in classroom to cover more content of the subject matter for improve students' learning. This is in agreement with the submission of Akbari and Allvar, (2010) that there is a high correlation between teachers' reflectivity and students' achievement. The reason according to the study is that reflective practice is first centered on students' learning.

The biology teachers' involvement in reflective teaching in the two experimental groups must have produced a positive impact on their understanding of what went on in their classrooms and as such produce changes in methodology. This would have brought about changes in their methodology and assessment which naturally improved students' achievement. Also, reflective activities must have made the biology teachers in the treatment groups to be more efficient due to critical consideration and analysis of their communication style, use of instructional materials, questioning and time management in

classroom, thus improving the students' achievement. This corroborates Akiri and Ugborugbo (2009) submission that effective teachers produced highly performing students. Since the result of the study shows an improvement in the classroom practices of biology teachers in the treatment groups, this implies that the teachers in the two reflective treatment groups might have been more effective and efficient than the teachers in the conventional group hence the students of those in the conventional group performed worse.

Students in the Reflective Focus Group Discussion (RFGD) strategy obtained the highest adjusted mean score followed by students in the Reflective Peer Observation (RPO) group in their achievements. Students in the conventional method group recorded the least performance. The advantage of students in the RFGD group might have been due to teachers' more reflective activities on classroom practice over the other two groups. The advantage of students of RFGD biology teachers over the students of teachers in the RPO strategy may also be due to the number of teachers who carried out reflective activities in the RFGD strategy. The more number of teachers in RFGD must have made it possible to compliment the biology teachers' strength and compensate their limitations or weaknesses on students' learning and performance during reflection more than RPO teachers. The teachers in RFGD group must have generated various ideas on teacher's communication style, use of instructional materials, questioning style and time management during reflective activities due to their number in the group which made the teachers to become more effective in improving students' learning and consequently students' achievement.

This finding is in agreement with Roig and Rivera (2013) who submitted that group reflection helps teachers to learn and modify their students' learning. The study further stated that reflective practice help teachers to improve practice and knowledge in assessing students' learning with understanding. The number of teachers who participated in the reflective activities in in RFGD must have contributed to better improvement of teachers in communication, use of instructional materials, questioning and time management which consequently improve students' learning. This also corroborates Farrell (2000) findings that teachers' collaborative group reflection indicates best

learning of teachers in skills, knowledge, beliefs and understanding in classroom learning to improve students' achievement.

The advantage of students in the RPO group over conventional method group must have been due to reflective activities of the teachers in this group. The teachers in the RPO group must have critically consider, analyse and evaluate their communication style, use of instructional materials, questioning and time management in order to improve students' learning and achievement. The improvement of achievement of students in RPO strategy over the conventional method may be that the biology teachers in RPO strategy according to Cakir (2010) were able to obtain new insight into aspect of their teaching which made them to come up with new ideas about their students' learning during post observation teaching which must have affected the students' achievement. The improvement in students of biology teachers in RPO strategy may also be as a result of improvement in the effectiveness of teachers in this group which occurred due to peer reflection of the teachers compared to conventional group where an individual biology teacher was responsible for planning of classroom teaching with no reflection hence such teachers are less effective. This is in support of Marzano and Toth (2012) who remarked that even small improvements in teacher's effectiveness can have a positive impact on students' achievement. It means that a little reflection by a teacher can influence teaching effectiveness and have a corresponding effect on students' achievement. Therefore, the little reflective activities by two teachers in RPO strategy must have produced positive influence on the teachers and students' achievement as compared to conventional group with only one teacher without systematic reflection. Butressing this view Pollard (2005) and Ajitoni (2008) submitted that reflective teaching leads to effective teaching which brings about improvement in students' learning.

5.1.2 Effects of Teacher's Reflective Teaching Knowledge on Teachers' Classroom Practices and Students' Achievements in Biology

The study showed that there was no significant effect of reflective teaching knowledge of teachers on teachers' classroom practices in biology. This implies that teachers' knowledge of reflective teaching strategy does not appear to influence teachers' classroom practices and students' achievement in the experimental and control groups.

This negates the findings of Holder (2004) that teachers' professional knowledge influences their practice.

The teachers' knowledge of reflective teaching may not influence the classroom practice if such knowledge is not put into practice. This implies that there is an existing gap between acquired knowledge and practice of reflective teaching. Acquisition of content knowledge of reflective teaching by teachers without adequate practice or application of the content may not produce effects on the teachers' classroom practices. This is in agreement with the findings of Posteguillo and Palmer (2000) and Holmes (2005) that the practice of reflective teaching, bridging the gap between theory and practice results in teachers gaining professional knowledge that is important to being effective in helping teachers to shape students' learning and achievement. The findings also support Navaneedhan (2011) declaration that reflective teaching is a continuous process which involves thoughtful consideration of one's experience in applying knowledge to practice. Engaging in reflective teaching is associated with the improvement of the quality of personal and professional growth and closing the gap between theory and practice. In other words, it is application of theoretical knowledge of reflective teaching that can have positive professional influence on teachers.

Furthermore, the study revealed that there was no significant effect of reflective teaching knowledge of teachers on students' achievement. The lack of effect of reflective teaching knowledge on students' achievements may also be due to an existing gap between teachers' acquisition of knowledge and application or practice of reflective teaching on teachers' classroom practices. This implies that the acquisition of knowledge of reflective teaching by the teachers does not correspond with its application in classroom practice. The lack of effect of teachers' reflective teaching knowledge on classroom practice may account for lack of its relative effect on students' achievement. Since there was no improvement on the biology teachers' classroom practices due to acquisition of reflective teaching knowledge, there would not be improvement on students' achievement. This is in support of Lieberman and Miller (2000) who pointed out that the practice of reflective teaching results in growing of personal and professional knowledge that is so important in being an effective teacher and in shaping students' behaviour. This means that the continuous practice of reflective teaching can improve

personal and professional knowledge as well as students' achievement but acquisition of knowledge without practice can neither improve nor impact teacher's classroom practice or students' achievement. In support of this finding, Dating-Hammond (2000) also pointed out that teacher's pedagogical knowledge and practice together profoundly affect students' achievement and not teachers' knowledge only.

5.1.3 Effect of Teachers' Gender on Teachers' Classroom Practices and Students' Achievement

The results showed that there was no significant effect of teachers' gender on teachers' classroom practices and students' achievement in biology. This implies that teachers' gender does not appear to influence teachers' classroom practices and students' achievements in biology. The implication of this is that biology teacher of any gender could learn and acquire content on subject matter and teaching pedagogy and its application in classroom practice. This finding is in support of Lowery (2003) who is of the view that teachers tend to teach according to the way they were taught during training and not according to gender. However, this finding is contrary to the submission of Chugar and Sankar (2008) that the effect of teachers' gender on classroom practice varied, though this may be mediated by the subject taught and teacher's own background. For example the study submitted that female teachers' classroom practices was better than male teachers' classroom practices in English language while in mathematics, there was no difference in teachers' gender difference. In this study, there was no difference in biology teachers' classroom practices based on gender. This means that teachers' gender do not have effect on teachers' classroom practice. The finding in this study is in line with Supovitz and Turner (2000) remark that teachers' professional content preparation has a powerful influence on teaching and classroom practice and not on teachers' gender. Therefore, the implication of the findings of this study is tht the quality and quantity of professional training possessed by teachers determines their practices. All teachers are expected to acquire and apply pedagogical skills based on acquisition of knowledge exposed to during and after training and not on gender.

The result of this study also revealed that there was no significant effect of teachers' gender on students' achievement. This implies that teacher's gender has no

effect on students' achievement in biology. This is in agreement with Dee (2004) and Carrell et al (2010) who claimed that gender difference between male and female teachers have no effect on students' in science subjects but may depend on the quality of acquisition and application of pedagogical skills of the teachers in teaching. This means that students' achievement in biology as a science subject does not depend on teacher's gender but rather on the quality of the teaching offered in classroom from which the students learnt or acquire knowledge on the subject matter. However, the finding negates Elstad and Turmo (2009) submission that male and female students respond to teachers on based on their biological differences or similarities. This means that students have higher achievement with teachers of similar gender than teachers with opposite gender. This implies that female teachers have positive effect on achievement score of female students and male teachers having positive effect on male students. However, this may depend on some other characteristics of the teachers such as teachers' knowledge of subject matter, gender stereotyped behavior of teachers against students' gender, etc. In Dee (2006) study it was acknowledged that apart from mathematics, teachers' gender is unrelated to students' achievement. Even in mathematics Antecol and Ozbeklik (2012) remarked that female students assigned to female teacher without strong mathematics background may suffer lower achievement score. The finding of this study is supported by Kauchak and Eggen (2007) view that teachers' performance in the classroom and effects on students' learning does not depend on teacher's gender but on other teachers' characteristics such as teacher's knowledge of the subject matter, pedagogical knowledge, gender stereotyped beliefs and attitudes of the teachers against students.

5.1.4 Interaction Effect of Treatment and Teachers' Gender on Teachers' Classroom Practices and Students' Achievement in Biology

The study revealed that the interaction effect of treatment and gender on teachers' classroom practice was not significant. It implies that the improvement of classroom practices of biology teachers as a result of reflective teaching is not gender biased. This is in agreement with Farrell (1999) and Roig and Rivera (2013) that reflective teaching help teachers to modify teaching-learning process in classroom irrespective of teachers' gender. However, the result obtained indicated that there was significant interaction

effect of treatment and teachers' gender on students' achievement. This is contrary to Akbari and Allvar (2010) and Nevaneedhan (2011) findings that the practice of reflective teaching produces better academic performance of students irrespective of teachers' gender. The interaction effect showed that the focus group discussion strategy was the most effective strategy for male biology teachers as well as their female counterparts. For both gender groups, the reflective peer observation strategy came second while the conventional method was the least effective across the gender grouping.

However, in reflective peer observation group, students of male teachers performed slightly higher in achievement scores than students of female teachers. This implies that the effects of the treatment on students' achievements in biology were sensitive to teachers' gender. The better performance of students in male teachers' classroom as compared to students in female teachers' classroom may be due to possession of other characteristics like good problem solving abilities by the male teachers. Possession of such other characteristics might have boosted the effect of reflective teaching on the students' learning in the ability of the male teachers to modify their teaching styles thus enhancing their students' achievement. Corroborating this assertion, Udeani and Adeyemo (2011) reported that a biology teacher with good problem solving abilities will be able to modify the teaching style to suit the students' learning style thus enhancing their academic achievement. The finding of the study may also be due to male teachers' ability to be consistent in the continuous application of reflective activities on students' learning. This implies that male teachers seem to have benefited more from reflective teaching strategies and they may have use more of these benefits to improve their teaching actions in relation to students' learning which resulted in better achievement of their students than those of female teachers.

5.1.5 Interaction Effect of Teachers' Reflective Teaching Knowledge and Gender on Classroom Practices and Students' Achievement.

The findings of this study revealed that there was no significant interaction effect of teachers' reflective teaching knowledge and gender on teachers' classroom practices and students' achievement. This implies that the effect of teachers' reflective teaching knowledge on classroom practices were not sensitive to teachers' gender and students

achievement. This may be due to the level of application of acquired reflective teaching knowledge in classroom practices irrespective of teachers' gender and consequence of such practice on students' achievements.

5.2 Conclusion

This study showed that reflective teaching had proved to be important in improving teachers' classroom practices and students' achievement. However, the study has also revealed that reflective teaching by reflective focus group discussion strategy improved teachers' classroom practices and students' achievement more than the reflective peer observation strategy does. This implies that with the practice of reflective teaching by biology teachers, especially with the strategies such as reflective focus group discussion and reflective peer observation, the classroom practices of teachers and students' achievement in biology would be improved. It is believed that applying reflective teaching to classroom practices in biology would greatly improve how, what and why teachers teach, as well as students' learning. Finally, teachers are likely to become more dynamic in classroom practice through the application of reflective teaching rather than depending on routine teaching experiences which may affect students' achievement negatively.

5.3 Implications of Findings

The study used two strategies of reflective teaching – reflective focus group discussion and reflective peer observation strategies in the teaching of biology in secondary schools in Oyo State. The findings of the study revealed that reflective teaching strategies were more effective than conventional method in teachers' classroom practices and students' achievements in biology. The findings of this study have some implications for biology teachers and students which are further explained below.

The results of this study showed that biology teachers were moved from the level of automatic or routinised response to classroom situations to achieve a higher level of awareness of value and consequences of classroom practices thereby creating dynamism

or flexibility in teaching approach. Therefore, it implies the findings have revealed that the practice of reflective teaching is potentially and immensely powerful in improving biology teachers' classroom practices and students' achievement.

The practice of reflective teaching enabled the male teachers to systematically and continuously collect data about their teaching, examine their beliefs, attitudes, assumptions and teaching practices and using that information as basis for critical consideration of subsequent teaching in biology may make great improvement on teachers' practices and students' learning. This subsequently, has made reflective teaching to be recognised as a possible crucial element of biology teachers' professional development and biology students' achievements.

5.4. Recommendations

On the basis of the findings of this study, the following recommendations are made:

Biology teachers should practice reflective teaching using reflective focus group discussion and reflective peer observation strategies.

Principals of secondary schools should encourage and motivate biology and other science teachers to practice reflective teaching through reflective focus group discussion and reflective peer observation strategies by providing adequate monitoring to support the teachers irrespective of teachers' gender. This will go a long way in assisting teachers to teach difficult topics and to improve students' performance in such topics and learning generally.

Government should organize in-service training for biology and other teachers to acquire necessary adequate knowledge needed in the practice of reflective teaching.

Professional bodies such as National Union of Teachers (NUT) and Science Teacher Association (STAN) should organize seminars and workshops for biology and science teachers to enable them acquire knowledge of the concepts and practice of reflective teaching especially through the use of reflective focus discussion and reflective peer observation strategies.

Curriculum planners need to consider reflective teaching by reflective focus group discussion and reflective peer observation strategies as indispensable tools in teacher preparation at National College of Education and University levels especially in Biology. hence the need for its inclusion in the teacher preparation curriculum at these levels.

Teacher educators who are curriculum implementers in teacher preparation programmes should learn about reflective teaching and regularly practice it especially by using reflective focus group discussion and reflective peer observation strategies to serve as role models to their students.

On the whole it is recommended that the teacher education programs should familiarize pre-service and in-service teachers with the components of approaches to reflective teaching especially by reflective focus group discussion and reflective peer observation strategies in order to educate effective teachers who in turn enhance student achievement.

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APPENDICES

APPENDIX I

TEACHERS' INSTRUCTIONAL GUIDE FOR REFLECTIVE FOCUS GROUP DISCUSSION STRATEGY (TIGRFGD)

This instrument was developed as a guide for participating teachers in focus group discussion strategy to carry out reflection before and after teaching of the sampled biology teachers.

Part One:

Reflection before teaching

- (i) The group will meet at scheduled time at the beginning of each week before the sampled teachers taught.
- (ii) The head of science department (HOD) who will act as the facilitator at each meeting during reflective discussion will coordinate and lead the group.
- (iii) Reflection before classroom teaching of the sampled teachers will come up once in a week.
- (iv) All the members of the group will critically consider, analyse and evaluate the classroom activities the teacher intends to carry out during teaching with respect to teaching methodology, content, intended learning and how learning would be accomplished.
- (vi) The group would participate in the critical thinking process and reach a conclusion based on the following:
 - (a) Pattern of starting the lesson:
 - (b) Exposition of concepts.
- using of appropriate words to reach the students (i.e without using vernacular)

- avoiding the use of vocabulary above students' level (i.e. words which the students would need dictionary to understanding its meaning).
 - avoiding repetition and use of distractive mannerism.
 - should the topic be sub-divided and how?
 - good voice projection that is audible to all the students (how this could be achieved).
- (c) Examination of instructional material(s) to be used for teaching, their nature/type, relevance, time of introduction, display and quality time to be spent on its use/explanation.
- (d) Activities to be carried out by teachers in the course of teaching e.g. calculation, experimentation, note given (from teacher's lecture note, from textbooks etc)
What activities should be carried out by the teachers, how and why these activities should be carried out.
- (e) Evaluation of lesson taught through questioning.
- Questioning patterns/modes of teachers with respect to levels to be covered including:
- 1) types of questions covering different areas of knowledge (recall, application, observation, analysis)
 - 2) time distribution of questions (i.e. what to ask, when to ask, how to ask, frequency of questions)
- (g) Time to enter and leave the classroom to avoid being too early or late to start or end the lesson. Time to be spend on each activity (i.e distribution of time to each activity to avoid digression during teaching).
- (h) Pattern of concluding the lesson.
- (i) The sampled teachers would go to their classrooms to teach based on agreed or concluded activities during reflection.

Part two:

Reflection after teaching

- (i) The group would meet at the scheduled time once at the end of each week after the sampled teachers have gone to their classes to teach.
- (ii) The facilitator will coordinate and lead the group in reflective discussion at each meeting.
- (iii) The sampled teachers will describe the classroom activities during teaching based on agreed or concluded reflected activities. The teachers would describe what worked and what do not work in class out of the activities concluded on during reflection before teaching the classes. This would be done by the sampled teachers in turns following the items as discussed during reflection before teaching.
- (iv) The group will critically consider, analyse and evaluate each of the activities as described by the teachers systematically based on the agreement of the activities during reflection before teaching.
- (v) The sampled teachers would be guided in describing the actions or activities by being asked questions. Such questions to guide reflection include:
 - a. how was the lesson started.
 - b. How the information or knowledge was passed to the learners. Is the topic divided into sub-topics and objectives written on each of the sub-topics? Were the lessons communicated sequentially based on divided sub-topics. Were the teachers able to communicate with the students using appropriate words without vernacular, avoiding repetition or distractive mannerism? How can the topic better be communicated at another time of teaching.
 - c. Do sampled teachers avoid use of vocabularies which are later interpreted during teaching? If no, the group will critically consider and make suggestions on how the teachers could make use of appropriate words to reach the students without distractive mannerism.

- d. Do students complain about your voice not being heard during teaching at particular part of the class? What was their complains like? How can such complain be reduced or removed? The teachers will make suggestions on how to improve voice modulation and eye contact with the students.
- e. The instructional materials would be examined if provided, displayed, used and relevant for the teaching by the sampled teachers. What other instructional materials could have better been used?
- f. What activities were students engaged with during teaching? Were the activities relevant and applicable? How was the note given to students? (i.e by writing on the chalkboard, dictating from teachers' note or written from a textbook, etc). The group will give suggestions on how best to give note on such topic to students.
- g. Were the students asked questions after teaching? Were the questions asked at the end of each sub-topic or at the end of the class teaching? Do the questions cover recall, application, observation and analysis. Were the questions well distributed over the lesson time. The group will critically consider and assess the questions asked by the sampled teachers during teaching and give their comments and suggestions.
- h. Consideration would be given to how the teachers made use of allocated time of lesson, how the time could better be utilized.
- k. Every member of the group will participate and contribute to the critical thinking process of each of the questions raised. Suggestions and conclusion would be made on each of the activities for better performance of the sampled teachers in the next teaching

APPENDIX II

TEACHERS' INSTRUCTIONAL GUIDE FOR REFLECTIVE PEER OBSERVATION STRATEGY (TIGRPO)

This instrument was developed as a guide for participating teachers in peer observation strategy to carry out reflection before and after teaching their classroom teaching respectively.

Part One:

Reflection before teaching

- (i) The two SS II Biology teachers will meet at scheduled time at the beginning of each week before they teach in their classes.
- (ii) Reflection before classroom teaching of the sampled teachers will come up once in a week.
- (iv) The teachers will critically consider, analyse and evaluate the classroom activities they intend to carry out during teaching with respect to teaching methodology, content, intended learning and how learning would be accomplished.
- (vi) The two teachers would participate in the critical thinking process and reach a conclusion based on the following:
 - (a) Pattern of starting the lesson:
 - Stating the objectives in measurable terms.
 - Linking the previous knowledge with new concept.
 - Relating the concept to students' environment.
 - (b) Exposition of concepts:
 - using of appropriate words to reach the students.
 - avoiding the use of vocabulary above students' level.
 - avoiding repetition and use of distractive mannerism.

- good voice projection that is audible to all the students.
- (c) Examination of instructional material(s) to be used for teaching, their nature/type, relevance, quality time of introduction, display and time to be spent on its use/explanation.
- (d) Activities to be carried out by teachers in the course of teaching e.g. calculation, experimentation, note given (from teacher's lecture note, and not from textbooks etc)
What activities should be carried out by the teachers, how and why these activities should be carried out.
- (e) Evaluation of lesson taught through questioning.

Questioning patterns/modes of teachers with respect to levels to be covered including:
 - i) types of questions covering different areas of knowledge (recall, application, observation, analysis)
 - ii) time distribution of questions (i.e. what to ask, when to ask, how to ask, frequency of questions)
- (g) Time to enter and leave the classroom to avoid being too early or late to start or end the lesson.
- (h) Pattern of concluding the lesson.
- (i) Each of the teachers would go to the classroom to teach based on or according to the agreed or concluded activities during reflection.
- (j) The teachers take turn to observe each other during teaching.
- (k) The observation procedure would be based on their agreement during reflection.

Part two:

Reflection after teaching

- a. The sampled SS II Biology teachers would meet at the scheduled time once at the end of each week after they have gone to the class to teach and observed each other.
- b. Each teacher will describe the classroom activities that were observed and discussed with the partner during teaching based on agreed or concluded reflected activities.
- c. The two teachers would critically consider, analyse and evaluate each of the activities as observed by the teachers systematically based on the agreement of the activities during reflection before teaching.
- d. The teachers would be guided in describing the observed actions or activities by following such questions like:
 - i) how and why were the objectives stated? How was the previous knowledge linked with new concepts and related to students' environment.
 - ii) How the information or knowledge was passed to the learners. Is the topic divided into sub-topics and objectives written on each of the sub-topics? Were the lessons communicated sequentially based on divided sub-topics? Was the teachers able to communicate with the students using appropriate words and avoiding repetition and use of distractive mannerism? How can the topic better be communicated at another time of teaching?
 - iii) Do students complain about your voice not being heard during teaching at particular part of the class? What was there complain like? How can such complain be reduced or removed? he teachers will make suggestions on how to improve voice modulation and eye contact with the students.
 - iv) How was eye contact maintained during teaching to capture students' attention?

- v) Do sampled teachers avoid use of vocabularies which are later interpreted during teaching? If no, the group will critically consider and make suggestions on how the teachers could make use of appropriate words to reach the students without distractive mannerism.
- vi) The instructional materials would be examined if provided, displayed, used and relevant for the teaching by the sampled teachers. What other instructional materials could have better been used?
- vii) What activities were students engaged with during teaching? Were the activities relevant and applicable?
- viii) How was the note given to students? (i.e by writing on the chalkboard, dictating from teachers' note or written from a textbook). The group will give suggestions on how best to give note to students.
- ix) Were the students asked questions after teaching? Were the questions asked at the end of each sub-topic or at the end of the class teaching? Do the questions cover recall, application, observation and analysis. Were the questions well distributed over the lesson time. The group will critically consider and assess the questions asked by the sampled teachers during teaching and give their comments and suggestions.
- e. Consideration would be given to how the teachers made use of allocated time for lesson, how the time could better be utilized.
- f. Every member of the group will participate and contribute to the critical thinking process of each of the questions raised. Suggestions and conclusion would be made on each of the activities for better performance of the sampled teachers in the next teaching

APPENDIX III

TEACHERS' INSTRUCTIONAL GUIDE FOR CONVENTIONAL METHOD

- (i) The teacher gathers materials ready for the classroom teaching.
- (ii) The teacher goes to the class to teach.
- (iii) After teaching, the teacher gathers materials for the next teaching.
- (iv) The teacher went to the class to teach the next lesson.
- (v) This is continued in this manner till the end of the study.

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APPENDIX IV

INSTRUCTIONAL GUIDE FOR FACILITATORS (IGF)

This instrument is developed as a guide for facilitators during reflective discussions of the focus group before and after classroom teaching of the sampled teachers.

- i. Head of science department (HOD) will act as the facilitator
- ii. He or she gathered the reflective group which was made up of the science teachers at the scheduled time.
- iii. He or she is to coordinated the group discussion during which the teachers will reflect on the teaching behaviours of the sampled teacher before and after teaching.
- iv. He or she was expected to lead the focus group to discussion based on the sequenced items and questions listed in Teachers' Instructional Guide for Reflective Focus Group Discussion Strategy.
- v. He or she was to initiate discussion on each item in the instruction guide-TIGRFGD.
- vi. The facilitator encouraged each member of the group to participate in the reflective discussion and lead them to a conclusion on each item indicated in the instructional guide.
- vii. He or she gives a conclusive statement on each item.

APPENDIX V

INSTRUCTIONAL GUIDE FOR OBSERVERS (IGO)

The instructional guide for observers is developed to direct the observers on what and how to observe the participating teachers' behaviour during teaching.

- i. The observers were trained research assistants
- ii. The observers used the instrument – Teacher's Classroom Practice Observational Scale (TCPOS)
- iii. He or she was expected to enter the classroom five minutes before the commencement of the lesson to observe the sampled teacher and stay till the end of the lesson.
- iv. Immediately the sampled teacher entered the classroom, the observer filled the initial data provided before observing the teaching actions according to the items.
- v. The observer commenced the observation of the sampled teacher immediately he or she starts teaching.
- vi. The scoring was based on the previous reflective discussion as concluded on each of the items in the guide of each treatment group as indicated in the scoring of the items in the observation instrument. 5-very good, 4-good, 3 – very fair, 2-fair, 1-poor.
- vii. A total number of eighteen (six lessons each for pre, mid and post treatment respectively) lessons was observed per sampled teacher.
- viii. Observer was expected to use an observational scale per lesson and per teacher.

APPENDIX VI

**TEACHER'S CLASSROOM PRACTICE OBSERVATIONAL SCALE
(TCPOS)**

PART A

SCHOOL:TEACHER'S SEX:

TEACHING EXPERIENCE:

TIME IN: TIME OUT:

Please use the rating scale in making your judgements.1-Poor, 2- Fair,

3-Very Fair, 4 - Good, 5- Very Good,

ITEMS	1	2	3	4	5
Communication Styles					
Reaches the students with the use of appropriate words.					
Teacher's voice modulation.					
Avoiding use of distractive mannerism.					
Communicating with notes to students.					
Makes eye contact with students.					
Use of Instructional Materials					
Provision of appropriate instructional materials.					
Quality of preparation of instructional materials.					
Students' interaction with instructional materials.					
Appropriate display of instructional materials.					
Effective uses the appropriate instructional materials.					

Teacher's Questioning.					
Pattern of asking students questions.					
Varies questioning mode covering recall, application and observation.					
Gives good time distribution to questions.					
Mode of direction of questions to students.					
Frequency of questions asked.					
Time Management.					
Begins the lesson at the appropriate time.					
Time distribution for different activities.					
Use of allocated time.					
Use of overtime.					
Under utilization of time.					

PART B

Scoring Guide for Teacher's Classroom Practice Observational Scale (TCPOS)

Communication Style

- 1 Reaches the students with the use of appropriate words
- The teacher communicates in English throughout the lesson. 5
 - The teacher communicates in English but explain some vocabulary in vernacular 4
 - The teacher uses English and vernacular intermittently in communicating with students during teaching 3
 - The teacher communicates mostly in vernacular with little English 2
 - The teacher communicates in vernacular throughout the teaching 1

- 2 Teacher's voice modulation.
- The teacher is heard clearly at the back of the class (teacher's voice is audible up to the back of the classroom) 5
 - The teacher voice is audible clearly only by students closer to the back 4
 - The teacher's voice is audible only to students in the middle of the class 3
 - The teacher's voice is audible only by students sitting in the front 2
 - Students generally complain teacher's voice is inaudible. 1
3. Avoiding of distractive mannerism.
- Avoids distractive mannerism throughout the process of teaching 5
 - Avoids use of distractive mannerism for 20mins while teaching 4
 - Avoids use of distractive mannerism for about 11-15mins while teaching 3
 - Avoids distractive mannerism for 10mins while teaching. 2
 - Uses distractive mannerism throughout the class period. 1
4. Communicating with notes to students.
- The teacher writes on the chalkboard while teaching. 5
 - The teacher writes note on the chalkboard after teaching. 4
 - The teacher dictates some part of the note to students and wrote some on the chalkboard while teaching. 3
 - The teacher dictates note to students while teaching. 2
 - The teacher neither writes nor dictates note. 1
5. Makes eye contact with students.
- Moves round the class within the students to keep eye contact with all of them. 5
 - Moves just into half of the classroom to keep eye contact with half of the students. 4
 - Stays in the middle of the class and maintains eye contact with students around him or her only. 3
 - Stays at a corner and maintains eye contact with students at that corner only. 2

- Stays only in the front of the class and avoids eye contact with students. 1

Use of Instructional Materials

1. Provision of appropriate instructional materials
 - All the instructional materials provided are appropriate 5
 - One of the instructional materials provided are inappropriate 4
 - Two of the instructional materials provided are inappropriate 3
 - More than two of the instructional materials provided are inappropriate 2
 - All the instructional materials provided are inappropriate/instructional materials are not provided at all 1
2. Quality of preparation of instructional materials
 - All the instructional materials are of good quality. 5
 - One of the instructional materials is damaged while others are good. 4
 - Two of the instructional materials are good while others are damaged 3
 - One of the instructional materials is good while others are damaged. 2
 - All the instructional materials are damaged or not provided. 1
3. Students' interaction with instructional materials
 - Students allowed to interact with all the instructional materials 5
 - Students interacted with three quarters of the instructional materials 4
 - The instructional materials are held up by the teacher as teaching goes on 3
 - The instructional materials are placed on a table in a corner. 2
 - All the instructional materials were not appropriately displayed. 1
4. Effective use of appropriate instructional materials.
 - All the instructional materials used are appropriate. 5
 - One of the instructional materials used is not appropriate. 4
 - Two of the instructional materials used are not appropriate 3

- Three of the instructional materials used were not appropriate. 2
- Instructional materials were not used or not appropriate. 1

Teacher's Questioning

1. Pattern of asking questions.
 - The teacher asks questions on all the subtopics 5
 - The teacher asks questions on all the subtopics but one 4
 - The teacher asks questions on all the subtopics but two 3
 - The teacher does not ask questions on more than two of the subtopics 2
 - The teacher does not ask questions on the subtopics 1
2. Varies questioning mode covering recall, application, observation and analysis
 - Ask questions covering all the questioning modes 5
 - Ask questions covering three of the questioning modes 4
 - Ask questions covering two of the questioning modes 3
 - Ask the questions covering one of the questioning modes 2
 - Does not ask questions at all/questions asked do not follow questioning mode 1
3. Gives time distribution to questions
 - Asks questions at the end of each subtopic. 5
 - Asks questions in the middle of the teaching. 4
 - Asks questions at the end of the teaching 3
 - Asks questions without following the subtopics sequentially. 2
 - Does not ask questions/ ask do you understand or is it clear? 1
4. Mode of direction of questions to students.
 - directs questions to individual student and encourage individual response. 5
 - directs questions generally to the entire class but encourages individual response. 4
 - directs questions to individual student but encourages chorus answers. 3
 - directs questions generally to entire students and encourages chorus answers. 2

- ask no question at all/ asks do you understand or is it clear? 1
- 5. Frequency of questions asked.
- Asks four questions throughout the lesson period. 5
- Asks three questions throughout the lesson period. 4
- Asks two questions throughout the lesson period. 3
- Asks only one question throughout the lesson period. 2
- No question asked/asked do you understand or is it clear? 1

Time Management

1. Begins the lesson at the appropriate time.
 - The teacher starts the lesson at the exact time. 5
 - The teacher starts the lesson one to two minutes late. 4
 - The teacher starts the lesson three to five minutes late. 3
 - The teacher starts the lesson six to eight minutes late. 2
 - The teacher starts the lesson more than eight minutes late. 1
2. Time distribution for different activities.
 - Used twenty minutes for lecture, ten minutes on instructional materials and ten minutes for questions. 5
 - Used fifteen minutes for lecture, ten minutes on instructional materials and fifteen minutes on questions. 4
 - Ten minutes used for lecture, fifteen minutes on instructional materials and fifteen minutes on questions. 3
 - Ten minutes used for lecture, twenty minutes on instructional materials and ten minutes on questions. 2
 - Does not distribute time for activities. 1
3. Use of allocated time for teaching.
 - The teacher taught throughout the allocated time for teaching. 5
 - The teacher uses three minutes for digression. 4
 - The teacher uses five minutes for digression. 3
 - The teacher uses eight minutes for digression. 2
 - The teacher uses above eight minutes for digression. 1

4. Use of overtime for the lesson.
- The teacher spent more than eight minutes extra before leaving the classroom. 5
 - The teacher spent extra eight minutes before leaving the classroom. 4
 - The teacher spent extra five minutes before leaving the classroom. 3
 - The teacher spent extra three minutes before leaving the classroom. 2
 - The teacher leaves the classroom exactly at the end of the lesson. 1
5. Under-utilisation of the allocated time.
- The teacher leaves the classroom more than eight minutes earlier. 5
 - The teacher leaves the classroom eight minutes earlier. 4
 - The teacher leaves the classroom five minutes earlier. 3
 - The teacher leaves the classroom two minutes earlier. 2
 - The teacher leaves the classroom at the end of the lesson. 1

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APPENDIX VII

Procedure for Training Observers

The observers were trained by the researcher following the sequence below:

Part One:

1. The researcher invited more than the required number of research assistants for the training. This is to have opportunity to select most qualified number to participate in the study.
2. Each research assistant is expected to possess a minimum qualification of Nigeria Certificate of Education (NCE) to qualify to participate in the training.
3. Ensures that all the invited research assistants (i.e prospective observers) are present at the training venue before the commencement of the training.
4. The observers were trained by the researcher using Teacher's Classroom Practice Observational Scale (TCPOS)
5. The researcher read out each item in the observational scale and explained it.
6. Read out the procedure for scoring each item in the guide along with the items and explained how the scoring would be carried out.
7. At the end of the explanation of each item in the guide the researcher showed a videotaped lesson for them to observe and use the observation scale and score the teacher in the classroom in the video using the guide to ensure the training was effective.
8. At the end of the explanations of all the items in the scale and use of videotaped lesson for scoring, the researcher asked if the trainees have questions on any part of the observational scale.
9. The researcher answered their questions and later asked the participants questions to ensure the instrument was clear to them.
10. Each participant was asked to read out and explain each item on the observation scale and how the scoring would be carried out using the observation scale.

11. Another recorded videotaped classroom lesson was shown to each participant to observe and score the teacher in order to ensure the training was effective. The researcher carefully examined how this was carried out by each participant.
12. The researcher used the checklist in part two to select the observer for each school.

Part Two: The following steps were used to checklist to select the best participants as observers.

S/N	Behaviour	Check	Comment
1	Availability of the participant at the scheduled time at the training venue.		
2	Participant showed signs of cooperation with the trainer.		
3	Attendance of the training from the beginning till the end by participant.		
4	Participant listened and demonstrated clarity of the teacher's classroom practice observation scale.		
5	Participant asks questions on areas not well understood or clear in the observational scale.		
6	Willingness to carry out the activities showed by the participant.		
7	The observational guide well read and explained by the participant.		
8	Ability of the participant to observe and score a recorded videotaped classroom teaching of a teacher.		

The participants who performed better in each school were selected as observers in each school.

APPENDIX VIII

Procedure for Training the Facilitators

The following sequence was followed by the researcher in training the facilitators.

Part One:

1. The Head of Science Department and his or her assistance were selected and participated in the training.
2. The researcher presented the instrument-Instructional Guide for Facilitator (IGF) to the participants.
3. Each of the items in the guide were read out and explained on how each activity would be carried out by the researcher while the participants carefully followed.
4. The researcher asked the participants for questions on any part of the instrument that was not clear.
5. The instructional guide –TIGRFGD was later presented to participants for treatment group 1 by the researcher.
6. Each item in the guide was read out and explained to the participants by the researcher.
7. It was explained to the participants by the researcher how each activity would be carried out and how the facilitator will lead the group to a conclusion on each item and questions were critically considered, analysed and evaluated.
8. Questions on any part of the instrument that were not clear to the participants were raised and re-explained by the researcher.
9. The researcher demonstrated the reflective activities (before and after teaching) on a sampled topic i.e skeleton and supporting tissues in animals to make the training more effective
10. Questions on the items in the instrument and how they would be carried out were directed to the participants by the researcher to clarify their ability to use the instruments.
11. The researcher used the checklist in part two to select the facilitator for each reflective focus group.

Part Two: The following steps were used to checklist to select the best participants as facilitators.

S/N	Behaviour	Check	Comment
1	Participant available for the training at the scheduled time and venue		
2	Interest and willingness to participate in the study well demonstrated by the participant.		
3	Proper attendance of the training by the participant (i.e the participant stayed throughout the traing period).		
4	Participant listened and demonstrated clarity of understanding on all the items in the instruments of the training.		
5	Participant could read out each item in the instruments clearly.		
6	Explanation of how each activity would be carried out well demonstrated by the participant.		
7	Participant could answer researcher's questions satisfactorily during the training		
8	Participant interacts with the instruments used for the training and asks the researcher questions.		

The participants who performed better in each school were selected as facilitator for the reflective focus group.

APPENDIX IX

BIOLOGY TEACHERS' REFLECTIVE TEACHING KNOWLEDGE TEST (BTRTKT)

This test is aimed at finding out Biology teachers' awareness, knowledge and practice of reflective teaching in Senior Secondary Schools. The response given will be treated confidentially as the information is strictly for research purpose. Kindly fill in your responses and tick (✓) the appropriate box. Thank you for your cooperation.

Time: 30 Minutes

Section A

Instruction: Kindly supply the necessary information and tick (✓) the appropriate option.

Name of School:

Gender:

Qualification:

Years of Experience: 0- 5 years (), 6- 10 years (), 11 years and above ()

Subject Taught:

Class or Level:

Section B

Reflective Teaching Knowledge Questions

Instruction: This section of the questionnaire is aimed at finding out Biology teachers' knowledge of reflective teaching practice. Kindly circle the correct option for the questions provided below.

1. Reflective teaching is practiced by
 - a. pre- service teachers only.
 - b. in- service teachers only.
 - c. pre-service and in- service teachers.
 - d. none of the above.
2. Which of these is not a strategy of practicing reflective teaching?
 - a. Focus group discussion.

- b. Peer observation
 - c. Lesson recording
 - d. Panel discussion
3. Reflection on effective application of teacher's skills in classroom practice is referred to as
- a. reflection-on-action
 - b. reflection-for-action
 - c. action - research
 - d. technical - rationality
4. One of the following is not a benefit of reflective teaching to teachers.
- a. continuous professional development.
 - b. development of higher standard of teaching.
 - c. development of knowledge of subject mastery.
 - d. continuous self improvement in the practice of one's teachings
5. Which of the following is not an advantage of reflective teaching?
- a. Deeper understanding of one's teaching style and ultimate greater effectiveness as a teacher.
 - b. Diversity in applying theory to classroom practice by a teacher
 - c. Validation of teacher's ideals
 - d. Development of specific teaching methods
6. What form of reflective teaching is critical thinking, analysis and evaluation of teachers' belief, attitudes and assumptions about teaching before classroom experience?
- a. Reflection - on - action.
 - b. Reflection - for -action.
 - c. Reflection-in-action
 - d. Technical rationality

7. Which of these is not an attitude of reflective teaching?
- Open-mindedness.
 - Wholeheartedness.
 - Responsibility.
 - Relativity.
8. Reflective teaching stems from Dewey's notion of comparison of
- routine action with reflective action.
 - routine act with reflective activity
 - routine action with reflective act.
 - none of the above
9. Which of these is the benefit of practicing reflective teaching?
- better academic performance of an individual teacher.
 - refining professional ability of teachers.
 - enhancing rational thinking among teachers.
 - promoting subject mastery ability in teachers.
10. Which of the following is not a characteristic of reflective teaching?
- Continuous monitoring of practice of teaching.
 - Evaluation and revision of practice of teaching.
 - Continuous critical thinking and analysis of practice of teaching.
 - Continuous inquiry into subject matter.
11. Reflective teaching involves
- Critical thinking, analysis and evaluation of teaching practice.
 - Critical consideration of teacher's belief, attitudes and assumptions about teaching.
 - Critical thinking, analysis and evaluation of lesson plan.
 - Critical thinking, analysis and evaluation of teaching practice.
12. A complete practice of reflective teaching involves one of the following
- stopping, noticing and examining teacher's teaching situation.
 - examining, analysing and evaluating teacher's teaching situation.
 - noticing, and examining teacher's teaching situation.
 - noticing, and evaluating teacher's teaching situation.

13. A form of reflective teaching which involves critical thinking, analysis and evaluation of teachers' beliefs, attitudes and assumptions about teaching after classroom experience is referred to as
- reflection-on-action
 - reflection-for-action
 - reflection-in-action
 - action research
14. Which of the following statement about reflective teaching is true?
- Reflective teaching is an organization of events.
 - Reflective teaching is a cycle of events.
 - Reflective teaching is a continuous chain of events.
 - Reflective teaching is a model of few numbers of activities.
15. Reflection on craft knowledge value to improve the rationality and social justice of one's educational practices is referred to as
- reflection-on-action
 - reflection-in-action
 - action research
 - technical rationality

APPENDIX X

STUDENTS' ACHIEVEMENT TEST IN BIOLOGY (HABITAT) – SATE

Time: 25 minutes

SECTION A

Instruction: Please supply the information in this section before proceeding to the next section. The information given shall be treated confidentially and strictly for research purpose. Thank you.

Name:

School:

Class:

Gender:

Age:

SECTION B

Instruction: Kindly choose the correct answer from the options provided in the questions.

- (1) Puddles, ponds, rivers, seas and oceans are grouped together as
 - a. ecosystem.
 - b. lithosphere.
 - c. aquatic habitat.
 - d. freshwater habitats.
- (2) Which of the following are adaptations of animals to aquatic habitats?
 - a. Gills, scales, skins and lungs.
 - b. Gills, streamlined bodies and lateral line.
 - c. Lateral line, streamlined bodies and lungs.
 - d. Gills, streamlined bodies and spiracles.
- (3) The most important physical factors which affect all plants and animals in a terrestrial habitat are
 - a. temperature and rainfall.
 - b. salinity and water current.
 - c. temperature and turbidity.
 - d. rainfall and ph.

- (4) Floating plants are called -----
- a. zooplanktons.
 - b. newtons.
 - c. phytoplanktons.
 - d. benthons.
- (5) The possession of breathing roots is characteristic of plants growing in
- a. sahel savannah
 - b. guinea savannah.
 - c. mangrove swamp.
 - d. rain forest.
- (6) Which of the following is an aquatic habitat?
- a. Desert.
 - b. Grassland.
 - c. Ocean
 - d. Forest
- (7) An aquatic habitat that is not moving is -----
- a. lotic.
 - b. lentic.
 - c. bentic
 - d. netic
- (8) Trees in the mangrove have -----.
- a. pneumatophores.
 - b. gametophytes.
 - c. sporophytes
 - d. oocytes
- (9) Which of the following is not an adaptive feature of animals to aquatic habitat?
- a. Fringed ears.
 - b. Eye shield.
 - c. Flat broad shape of some snakes.
 - d. Large ear lobe.
- (10) A low and wetland habitat representing a transition between aquatic and terrestrial habitat is -----.
- a. marshland.
 - b. brackish.

- c. forest.
d. desert.
- (11) The surface of a marine habitat is called the -----
a. intertidal zone c. aphotic zone
b. littoral zone d. sub-tidal zone
- (12) An adaptation of red mangrove plant is -----
a. leaves of some plants secrete salt.
b. seeds of mangrove plant can germinate while still attached to its parent plants.
c. soil is waterlogged and low in oxygen.
d. all of the above.
- (13) Aquatic habitat presents the following problems to aquatic organisms except
a. Reduced gaseous exchange
b. Reduced transpiration.
c. Absence of water.
d. Reduced light penetration.
- (14) The few number of trees is characteristic of the savannah zones in Nigeria because
a. there is too much sunlight.
b. there is limited amount of rainfall.
c. they are exposed to grazing animals.
d. they are covered by mountains.
- (15) Majority of aquatic plants are characterized by
a. the absence of stomata.
b. the reduction of leaves to spines
c. a well developed root system.
d. the absence of woody materials.
- (16) Which of the following is not an example of freshwater food chain?
a. Seaweed → limpet → carnivorous snail.
b. Diatom → Copepod → Barnacle → Carnivorous snail.
c. Diatom → Worm → Shrimp → Bird.
d. Diatom → Fly → Toad → Snake.

- (17) The largest and deepest aquatic habitat among the following is -----
- a. ocean.
 - b. sea.
 - c. lake.
 - d. river.
- (18) Epiphytes are usually found in ----- habitat.
- a. desert.
 - b. forest.
 - c. marshland.
 - d. grassland.
- (19) Which of these is a characteristic of the marine habitat?
- a. Changes in temperature.
 - b. High salinity.
 - c. High oxygen concentration.
 - d. Low oxygen concentration.
- (20) Which of the common ecological factors are common to both terrestrial and aquatic habitat?
- a. Rainfall, temperature, light and wind.
 - b. Salinity, rainfall, temperature and light.
 - c. Tides, winds, rainfall and attitude.
 - d. PH, salinity, rainfall and humidity.
- (21) The savannah is different from a rain forest by having trees.
- a. with fire-resistant thick barks.
 - b. that are usually ever tall.
 - c. with thin barks.
 - d. with broad leaves.
- (22) Which of the following is a xeromorphic plant?
- a. Cactus.
 - b. Waterleaf.
 - c. Waterlily.

- d. Balsam plant.
- (23) Which of the following is not a type of estuary?
- a. Tidal marshes.
 - b. River mouth.
 - c. Embayment.
 - d. Pandanus.
- (24) The unique habitat created by mixing of fresh and salt water is -----
- a. brackish.
 - b. river.
 - c. lake.
 - d. ocean.
- (25) The factors that determine the distribution of vegetation zones are
- a. temperature, light, air and humidity
 - b. humidity, snow, frost and dew.
 - c. light, humidity, air and mist.
 - d. temperature, light, rain and humidity.

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APPENDIX XI

AN EXAMPLE OF REFLECTIVE ACTIVITIES ON A GIVEN TOPIC (SKELETON AND SUPPORTING TISSUES IN ANIMALS)

Part One:

Reflection before teaching.

Critically thinking, consideration, analyses and evaluation on how to teach the topic – skeleton and supporting tissues in animals following the sequence below:

- (a) How to state the objectives in measurable terms, link the concept with previous knowledge, relating the concept to students environment, How to use simple English language throughout the process of teaching, how to avoid use of unfamiliar vocabularies which is above the students' level and teaching in local language which may or may not cause distractive mannerism.
- Presenting teaching and maintaining audible voice in the classroom to all the students (e.g by moving within the students, maintaining eye contact etc)
- (b) Appropriate instructional materials for teaching the concepts e.g fresh or preserved earthworm, cockroach and rat, when and why they are to be introduced, quality, relevance and how they are to be effectively utilized.(i.e placement, display, use, etc)
- (c) How and what to engage the students in e.g note taking, handling of specimens, etc.
- (d) Evaluating the students: how to (e.g through questions which involve recall, analysis, application, observation), when to, (e.g at the end of each sub-topic, in the middle of the lesson, at the end of the whole lesson), examples of questions which could be asked.
- (e) How to use the allocated time wisely and avoid overtime and under usage. questions are answered e.g good answer clap for her or him, try more you can do better.
- (f) How to summaries and conclude the lesson in one or two sentences.

- (g) The facilitator will lead the group to reach a consensus on each of the items
- (h) The teacher writes the lesson note and goes to the class to teach based on the conclusion reached during reflective discussion

Part Two:

Reflection after teaching

Critical thinking, consideration, analyses and evaluation of how and why teaching was carried out in respect to the following teaching behaviours sequentially

- (a) Teacher's verbal communication in class.
 - Was the teacher's verbal communication in class appropriate? i.e was it in simple English through out, was unfamiliar vocabularies and distractive mannerism avoided?
 - How to communicate better in simple English throughout the process of teaching, avoiding unfamiliar vocabularies above students' level, teaching in vernacular, distractive mannerism.
 - Was audible voice appropriately maintained at every part of the classroom? E.g by moving within the students, by maintaining eye contact with the students while teaching,
 - How audible voice could be improved in classroom throughout the teaching period.
 - Students' engagement in the process of teaching. E.g note taken.
- (b) Communication with instructional materials.
 - More appropriate instructional materials. e.g an insect, an earthworm, a small mammal such as rat.
 - Appropriate display of the instructional materials. i.e where and how they could better be displayed.
 - Appropriate and adequate utilization of the instructional materials. E.g correct material used to explain correct concept.

- How students' could better be engaged in the use some instructional materials.
 - Consideration of better way of communicating with instructional materials.
- (c) Evaluation of students.
- Consideration of appropriate way of asking students questions- the mode of questions to ask, when to ask and time to spend on it.
- (d) An improved way of allocating time to each aspect of teaching. E.g asking of questions.
- Was overtime and under-utilisation of time avoided?
 - How to perform better in future.
- (e) Concluding the lesson.
- How was the lesson concluded?
 - Better alternatives for concluding the lesson.

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APPENDIX XII

LESSON NOTE FOR SAMPLED TEACHERS IN EXPERIMENTAL GROUP 1

Date:

Subject: Biology

Class: SS II

Topic:

Time:

Objective: The biology teacher states the objectives based on the consensus reached or agreed upon on the topic during reflective discussion of the focus before teaching.

Instructional Materials: The teacher states and uses the materials concluded upon during reflection before teaching action as relevant or appropriate for teaching the topic taught.

Prior Knowledge: The biology teacher states the prior knowledge given and agreed upon during reflection as appropriate for linking the topic.

Introduction: The teacher introduces the topic as agreed upon during reflective activities.

Presentation: The teacher presents the topic in sequential arrangement of topic to be taught, language use appropriate for the level of students and avoidance of repetition of words as agreed during reflective activities of the group before teaching.

Evaluation: After the presentation of the topic, teacher evaluates the students by using effective questioning style agreed on in the group reflection.

Conclusion: The biology teacher summarises and concludes the lesson as stated and agreed upon during reflection before teaching by the focus group.

APPENDIX XIII

LESSON NOTE FOR SAMPLED TEACHERS IN EXPERIMENTAL GROUPS 2

Date:

Subject: Biology

Class: SS II

Topic:

Time:

Objective: The biology teacher states the objectives based on the consensus reached or agreed upon on the topic during the reflective activities of the peered biology teachers before teaching.

Instructional Materials: The teacher states materials concluded as relevant or appropriate for the topic during reflection before teaching action.

Prior Knowledge: The biology teacher states the prior knowledge given and agreed upon during reflection as appropriate for linking the topic.

Introduction: The teacher introduces the topic as agreed on during the peered biology teacher's reflective activities before teaching.

Presentation: The teacher presents the topic in sequential arrangement of topic to be taught, use of language appropriate for the level of students and avoidance of repetition of words as agreed during peer reflective activities of the teachers before teaching.

Evaluation: After the presentation of the topic, teacher evaluates the students by using effective questioning style agreed on in the peered reflection.

Conclusion: The biology teacher summerises and concludes the lesson as agreed upon during reflection before teaching by the paired biology teachers.

APPENDIX XIV

LESSON NOTE FOR SAMPLED TEACHERS IN CONTROL GROUP

Date:

Subject: Biology

Class: SS II

Topic:

Time:

Objective: The biology teacher states the objectives

Instructional Materials: The teacher states materials

Prior Knowledge: The biology teacher states the appropriate prior knowledge for linking the topic on a personal note.

Introduction: The teacher introduces the topic

Presentation: The teacher presents the topic as appropriate as possible, use of language appropriate for the level of students and avoidance of repetition of words

Evaluation: After the presentation of the topic, teacher evaluates the students by using perceived effective questioning style.

Conclusion: The teacher summarises and concludes the lesson appropriately.

Assignment: The teacher gives the students appropriate assignment in preparation for next lesson

APPENDIX XV

SELECTED TOPICS UNDER ECOLOGY TAUGHT BY THE BIOLOGY TEACHERS FOR THE STUDY.

Week	Topic
One	Marine Habitat a) Characteristics of marine habitat. b) Major zones of marine habitat. c) Distribution of organisms in marine habitat d) Adaptive features of marine organisms
Two	Freshwater Habitat. a) Characteristics of freshwater habitat. b) Types of freshwater. c) Distribution of organisms in freshwater habitat. d) Adaptive features of freshwater organisms.
Three	Estuarine Habitat. a) Characteristics of estuary habitat. b) Types of estuary habitat. c) Distribution of organisms in estuarine habitat. d) Adaptive features of organism in estuarine habitats.
Four	Marsh a) Characteristics of a marsh. b) Formation and types of marshes. c) Plants and animals that live in marshes. d) Adaptive features of organisms in marshes.

Five

Forest

- a) Characteristics of a forest.
- b) Strata in the forest.
- c) Distribution of organisms in a forest.
- d) Adaptive features of organisms in a forest.

Six

Grassland

- a) Characteristics of grassland.
- b) Types of grassland:
 - i) Temperate grassland.
 - ii) Tropical grassland (i.e the savanna).

Seven

Organisms in Grassland.

- a) Distribution of organisms in grassland.
- b) Adaptive features of organisms in grassland.
- c) Some adaptations of organisms in grassland communities:
 - i) air-conditioned nests e.g by termites.
 - ii) thick barks e.g baobab and palms.
 - iii) leaf fall.
 - iv) Underground stems e.g grasses.

Eight

Arid Lands

- a) Characteristics of arid lands.
- b) Types of arid lands.
- c) Distribution of organisms in arid habitat.
- d) Some adaptations of organisms to arid lands:
 - i) water conservation in plants and animals.
 - ii) body temperature regulation in plants and animals.



Plate 1: The researcher training the participants for reflective focus group discussion strategy.

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Plate 2: The researcher training a reflective peer observation strategy group.

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Plate 3: The researcher demonstrating scoring of classroom practice observation of a recorded classroom teaching of a teacher on video to observers during their training.

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Plate 4: The researcher interacting with facilitators and instrument during training.



Plate 5: A reflective focus group discussion strategy during reflective activities.

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Plate 6: A reflective peer observation strategy group with an observer during reflective activities.

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Plate 7: An observer observing a teacher in classroom during teaching.



Plate 8: Students of Holy Trinity Grammar School Old Ife road Ibadan during administration of achievement test (SATB).

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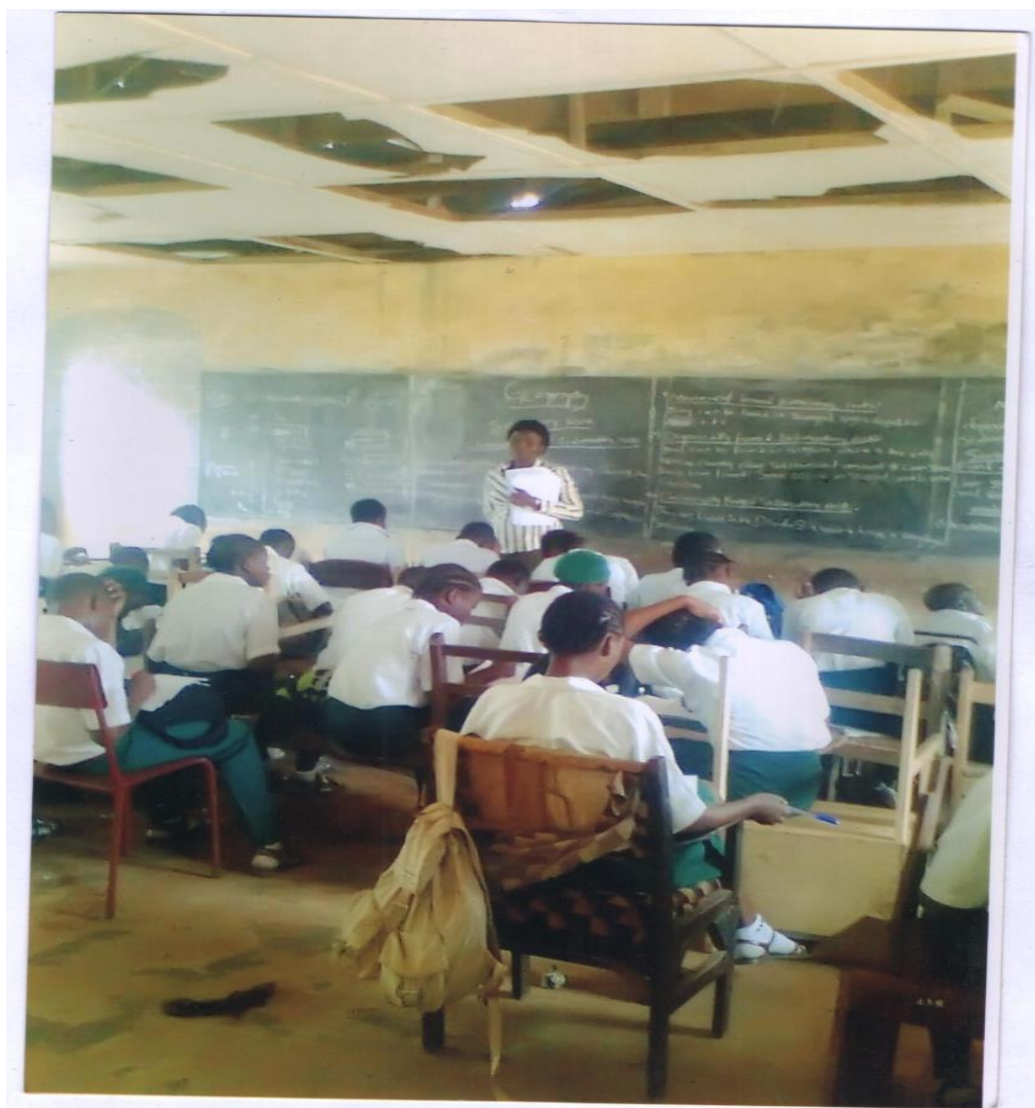


Plate 9: Students of Eleyele High School Eleyele, Ibadan during administration of achievement test (SATB).