PRE-SERVICE TEACHERS' PEDAGOGICAL CONTENT KNOWLEDGE DEVELOPMENT AND ITS EFFECT ON PUPILS' LEARNING OUTCOMES IN BASIC SCIENCE IN OGUN STATE, NIGERIA

BY

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ABSTRACT

Pedagogical Content Knowledge (PCK) is the integration of subject matter expertise with the teaching skills required for effective instructional delivery. Reports have shown that the PCK of most final year Pre-service Teachers (PsTs) is low; a trend partly attributed to inadequate teacher preparation. Previous studies largely focused on the effects of specific teaching strategies and subject-matter knowledge on pupils' learning outcomes, neglecting the training to develop PsTs' PCK. Therefore, this study was carried out to equip PsTs with PCK through group Interactive Strategy (GIS) and then determine its effects on pupils' learning outcomes in basic science in Ogun State. The moderating effects of self-efficacy and school location were also examined.

Sociocultural and Social Cognitive Learning theories provided the framework, while the mixed methods of pretest-posttest control group quasi-experimental design and phenomenological approaches were adopted. Purposive sampling strategy was used to select two public colleges of education with Primary Education departments in Ogun State, while intact classes of final year PsTs were enumerated and randomly assigned to GIS (100) and conventional strategy (82).The PsTs in the GIS group were trained on PCK for four weeks. Twelve PsTs who scored 65.0% and above in GIS group and 12 PsTs from the control group were randomly selected and assigned to teach basic science in selected primary schools. Twelve public primary schools with two arms of Primary VI were purposively selected (six each from rural and urban schools) and 24 PsTs were assigned to intact class of 210 pupils in the second phase. Instruments used were PCK (r=0.83) and Basic Science Achievement (r=0.75) tests; Attitude to Basic Science Questionnaire (r=0.75), Self-efficacy Scale (r=0.83) and instructional guides. Four sessions of in-depth interview were held with pre-service teachers. Quantitative data were subjected to descriptive statistics and Analysis of covariance at 0.05 level of significance, while qualitative data were content analysed.

The PsTs and primary school pupils were 19 ± 2.00 and 10.00 ± 2.00 years, respectively, while the intact classes in the urban schools had more pupils (60.0%). Treatment had a significant main effect on pupils' achievement in basic science ($F_{(1;212)}=100.88$; partial $\eta^2=0.33$). Pupils of PsTs with improved PCK had a relatively higher achievement mean score (23.90) than their counterparts (21.16). Treatment had

a significant main effect on pupils' attitude to basic science ($F_{(1;212)}$=11.03; partial η^2=0.94). Participants in the treatment group had a higher mean attitude score(19.23) than their counterparts (17.58). Treatment and school location had a significant disordinal interaction effect on pupils' achievement ($F_{(1;212)}$=48.86; partial η^2=0.19) and attitude (($F_{(1;212)}$=20.51; partial η^2=0.09). Urban pupils in the treatment group had higher achievement and attitude scores. There were no significant two-way interaction effects of treatment and self-efficacy, self-efficacy and school location and three-way interaction effects on dependent measures.

The training of pre-service teachers through group interactive strategy enhanced pedagogical content knowledge and pupils' learning outcomes in basic science, more in urban than in rural schools. Teacher education programmes should adopt pedagogical content knowledge development for preparing pre-service teachers.

Keywords: Pedagogical content knowledge, Group interactive strategy, Pre-service teacher, Achievement in basic science

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DEDICATION

This work is dedicated to Almighty God

CERTIFICATION

I certify that this work was carried out by Mr. Tunde Seinde Durowoju in the Department of Science and Technology Education.

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LIST OF ABBREVIATIONS

BECE:	Basic Education Certificate Examination.
CoRe:	Content representation.
GIS:	Group interactive strategy.
NCCE:	National Commission for Colleges of Education.
NCE:	Nigeria Certificate in Education.
PCK:	Pedagogical Content Knowledge.
PST:	Pre-service Teacher.
STAD:	Student Team Achievement Division.
SUPEB:	State Universal Primary Education Board.

CHAPTER ONE
INTRODUCTION

1.1 Background to the Study

Science and technology have proved significantly useful in humans' daily struggle to control the environment and build a virile world. Besides, the rapid pace of globalisation in most parts of the world has fuelled the use of science and technology as a means of solving human problems and attaining the Sustainable Development Goals (SDGs) (UNESCO 2016). Therefore, Science Education has become essential for any nation to compete favourably with her contemporaries all over the world. Science Education is expected to produce potential scientists and equip them with skills, knowledge and attitudes that would enhance the global, economic, social and industrial growth that are increasingly driven by the advancement of science and technology.

In realisation of this fact, several workshops and seminars were organised by the government for teachers of Basic science particularly in primary schools. Thisintervention justifies the position of Ahiakwo (2005) and Onwu (2002) that the teaching of science should begin from primary schools when children are more inquisitive and enthusiastic about their immediate environment. Hickey (2005) corroborates this view when he submitted that children's first year in school is a period in which the cognitive, affective and social processes are constructed and transmitted. Thus, the desire to make science education relevant to the child and societal values culminated into the development of a curriculum.The introduction of Science core curriculum has a significant effect because it promoted the teaching of Science and highlighted a set of objectives expected of a Nigerian child.

The need to attain the objectives of Basic Science education has necessitated various modifications in the name, content, methods of teaching and evaluation of sciences at the primary school. For instance the name of the subject was changed from primary science to General Science, then to Elementary Science in 1972. Thereafter it was changed to Basic Science in 2004 based on the Nigerian Basic Science Project (NBSP). Furthermore in 2008 and 2012, there were notable innovations in the primary science curriculum to cater for the lower and middle level of Basic Education (FGN, 2013). At present, the name Basic Science and Technology has been adopted and

Basic Science is taught as a theme. The structure of the Basic Science and Technology curriculum is illustrated in table 1.1

Table 1.1: Structure of Basic Science and Technology Curriculum

Theme	Primary Sub-theme
Basic Science	• Exploring the environment • Living and non – living things
Basic Technology	• Introduction to basic technology • You and energy

Source: (FME, 2012)

According to Abdul Hamid (2012) thecontent areas of the curriculum wereintegrated around unifying themes and Basic science is presented as a core subject. This implies that all students offer the subject, leading to large class-size thereby contributing to the challenges of implementing the curriculum.On the basic science curriculum, Okoruwa, (2014), acknowledges that the curriculum was well intentioned and well defined but the implementation suffered serious setback of language of instruction, inadequacies of physical environment, infrastructure and lack of qualified teachers. Also, studies from Okpala (2011),Akinbote (2009), Abdul Hamid (2012) and Ahmadi (2015) showed that foremost among the myriad of challenges inhibiting the effective implementation of the curriculum are inadequate specialist/teachers for primary schools, dearth of relevant support materials and inadequate training programmes for teachers. Perhaps that was the genesis of underachievement and negative attitude to science in the primary school. In addition, Oloruntugbe (2011) and Duze (2011) raised the issue of teachers who are the implementers of instructional programmes not being carried along during curriculum development and innovations. Apart from this, Okorie (2001), and Adamu (2010) identified several factors such as inappropriate selection of instructional strategies by the teachers, inadequate facilities, and negative attitude of students towards science as factors inhibiting the attainment of the objectives of science teaching and learning.

The Universal Basic Education (UBE) in Nigeria is a nine-year programme. Although, there is no terminal examination for Basic six pupils in Ogun State particularly in Basic Science, the result obtained from the optional Basic Education Certificate Examination (BECE) conducted for private students by National

Examination Council (NECO) and the compulsory Basic Education Certificate Examination (BECE) conducted by Ogun State Ministry of Education in the ninth year of the Basic Education Programme showed a poor performance of students in Basic Science as evidenced by BECE results and the general comments of BECE examiners.. These results could justifiably describe the performance of Basic Six pupils since the same set of students do the BECE in their ninth year of the Basic Education Programme. Table 1. 2 shows the trend of performance of Basic Science students in BECE in Ogun State from 2011 – 2017, while Fig 1.1 presents a pictorial illustration of the trend of performance.

Table1.2: Academic performance of students in BECE in Basic Science from 2011 to 2017 in Ogun State

YEAR	NO. OF CANDIDATES	NO. OF DISTINCTION	%	NO. OF CREDIT	%	NO. OF PASSES	%	NO. OF FAILURE	%
2011	72,380	4,458	6.15	36,353	50.22	29,116	40.26	2,453	3.38
2012	79,961	4,227	5.28	38,121	47.67	43,437	44.298	3,328	4.04
2013	89,183	6,389	7.16	69,750	78.26	11,041	12.30	2,003	2.24
2014	94,188	5,122	5.43	51,833	55.03	34,558	36.69	2,675	2.84
2015	96,108	8,922	9.3	40,180	41.8	42,294	44	4,712	4.9
2016	96,797	9,110	9.42	42,156	43.55	40,628	41.972	4,894	5.05
2017	90,379	13,150	15	48,799	54	15,695	17.4	12,735	14.1

Source: Ogun State Ministry of Education, Science & Technology 2018

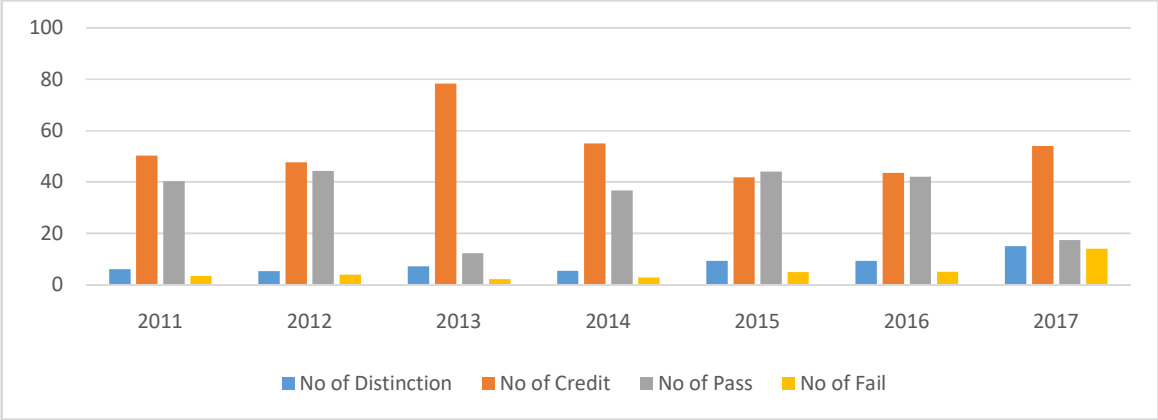


Fig. 1.1 Graph showing the performance of students in Basic Education Certificate Examination (BECE)in Basic Science from 2011 to 2017

As stated in Table 1. 2 and Fig. 1.1, it could be observed that there was a surge in the population of students writing the BECE. 72,380 in 2011 and 96,108 in 2015,96,797 in 2016 and 90,379 in 2017 while the number of students who obtained credit in 2013 was 78.26%, 2014 -55.03% and 2015 was 43.55%. In addition, 50.22% passed at credit level in 2011, 47.67% in 2012,78.26% in 2013,55.03% in 2014, 41.8% in 2015,43.55% in 2016 and 54% students in 2017. Further to this, the dismal performance in the examination make students switch to the Arts and Social sciences due to insufficient pre-requisite science subjects. Table 1.3 andFig.1.2 gives a clearer picture of the performance level of students in Basic Science in BECE from 2011 – 2017.

Table 1.3: Performance of Students in BECE on the Basis of Credit Level from 2011 to 2017 in Basic Science in Ogun State

Performance	2011	2012	2013	2014	2015	2016	2017
Greater or equal to credit	56.3%	52.6%	85.3%	60.4%	52.9%	52.9%	69%
Less than credit	44.7%	47.4%	14.7%	39.6%	47.1%	47.1%	31%

As stated in Table 1.3, Between 2011-2017, the only year when students performed very better was 2013 where 84% of the students passed at credit level and above but for subsequent years in 2014 and 2015 students who passed at credit level had reduced to 60.4% and 51% respectively, while in 2016 and 2017 students who had a minimum credit pass were 52.9% and 69% respectively. By implication 40.6% and 49% of students in 2014 and 2015 respectively, 47% and 31% of students in 2016 and 2017 respectively were not qualified to study science in senior secondary school as a result of their performance. This poor and inconsistent performance of students had provided a good reason to elicit concerns from government and science educators particularly when a credit pass in Basic Science is required for a student to offer science courses at senior secondary school.

The fact that pupils exhibit underachievement in Basic Science was also reported by a presidential committee set up to investigate whether there is any observable improvement in pupils' performances in basic science before and after the introduction of UBE. According to Wasagu (2010) the committee found out that

there was no remarkable impact mainly because most teachers lack basic teaching skills and pedagogy. In addition, an extract from the Science Teachers Association (STAN) 27th Annual Conference report as cited by Abdul Hamid (2012) revealed that there was under achievement of pupils in basic science as a result of teachers' incompetence and negative attitude to work.

A diagnostic study conducted by Salami and Folaranmi in 2015 on pupils' performance in basic science in primary schools, corroborated the assertion that pupils exhibited under achievement and negative attitude to science in primary schools. In addition, about 60% of students in senior secondary schools offering Art or Commercial subjects indicated their initial desire to venture into science disciplines when they were in primary schools but they changed their choice of subject due to negative attitude and fear of failure (Durowoju and Ige, 2016). Therefore, the expediency to train teachers for optimum performance in the teaching of science is not an exaggeration.

In Ogun State, for instance more than 75% of teachers in public primary schools are from Non-Science based disciplines like Arts and Social Sciences (SUBEB, 2016). The practice in private primary schools as documented by Oduwaye (2008) is that school certificate holders are allowed to teach basic science because proprietors of these schools want to maximise profit at the expense of the pupils. To further compound the problem, the practice whereby only one teacher teaches all subjects in primaries I-VI makes some teachers skip topics and avoid Basic Science as a result of difficulty in teaching some science concepts occasioned by inadequate training (Durowoju, Adeniji and Oke 2018) This may also account for the poor achievement in and negative attitude of pupils to science in primary schools.

Several variables may affect students' learning outcomes in basic science. These include poor facilities, resource allocation, demographic factors,class-size and class schedules (Kudari 2006, Alagoa 2015, and Singh 2016). Among all the variables identified, scholars and science educators are in consensus that teachers' factor plays a prominent role than any other (Patrick, 2005; Waseka, Simatwa and Okwach, 2016). Although, a number of institutions have been established by government to train teachers, concerns raised by scholars (Oyawoye ,2012; Okpala, 2011; Wasagu, 2010) that a gap exist between certificate obtained and performance displayed by teachers. This implies that the training obtained by teachers in these institutions is becoming obsolete in the fast changing,technology-driven society. This state of affairs provides

justification for this study. In addition, the fact that most studies on pre-service teachers and learning outcomes have been on other disciplines or on science teaching at the Senior Secondary level,Dike (2000) calls for the need to investigate issues of teacher preparation and science teaching and learning in the lower basic education level. The apathy of teachers to the teaching of science has been recorded by Oduwaye (2008), Kapton (2012) and Ige (2017) when they found out that many teachers are not confident in the teaching of science and technology, they engage in memorization of products of science (facts, theories and laws) without recourse to its process and barely use "hands-on" and "minds-on" science activities. That is why variables like Pre-service Teachers', PCK and teachers' self-efficacy have been aptly selected for this study. The justification for the choice of these variables in literature is found in the works of Kind (2009) and Coe, Aloisi, Higgin and Major (2014) who identified them as constituents of great teaching that can lead to improved students' achievement. These variables are also capable of determining the right type of knowledge necessary to enhance desirable student learning outcome in Basic Science particularly in primary schools.

PCK is the integration of subject matter expertise with the skills required for effective instructional delivery. According to Abimbola (2013), there are three forms of knowledge and the harmonisation of these knowledge concepts ensure that adequate learning takes place. Kylic (2009) argued that a teacher does not easily attain abalance among all types of knowledge essential to enhance students learning except through continuous effort over time. Scholars and stakeholders in education sector have also been investigating the type of knowledge a teacher should possesses and how the knowledge can be developed and integrated into teacher education programmes (Shulman 1986 and Usak 2005). In addition, Newborn (2001) reiterates that an answer to the type of knowledge a teacher should possess is assumed to be subject matter knowledge (SMK) but according to Kylic (2009) the general concern that SMK is not ideal for effective teaching has generated an unresolved controversy.In this regard, Kauchak and Eggien (2007) cited by Ige (2017) indicated that the decision teachers make are determined by teachers' knowledge of content (subject matter), how to translate specific knowledge into forms students can understand (PCK), general knowledge (Pedagogy) and use of teaching strategies (Methodology).Ball (2000) previously proposed that when preparing undergraduateteachers, we haveto resolve the ambiguity that permeates what

knowledge they should possess for effective teaching. It is based on the contradictions in research and inconclusive debate and opinion about the right type of knowledge suitable for effective teaching and how that knowledge is actually learnt in the classroom that has made it a necessity for more studies on the issue of teachers' knowledge since it appears the question is yet to be answered.

Shulman (1986) investigated the type of knowledge a teacher must have under three components. These are content, pedagogical and Pedagogical Content Knowledge. He noted that the integration of content expertise with teaching skills (PK) constitute PCK as illustrated in figure 1.2

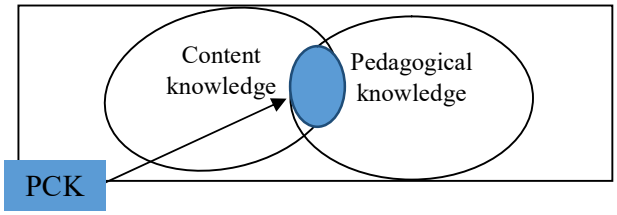


Fig. 1.2.: Pedagogical Content Knowledge

Source: (Shulman,1986)

Furthermore, Grees-Newsome (1999) conceived PCK as a synthesised knowledge-base for teaching, and proposed the idea that PCK emerged as an integration of subject matter knowledge (SMK), pedagogical knowledge (PK) and contextual knowledge (CK) as illustrated in Figure 1.3.

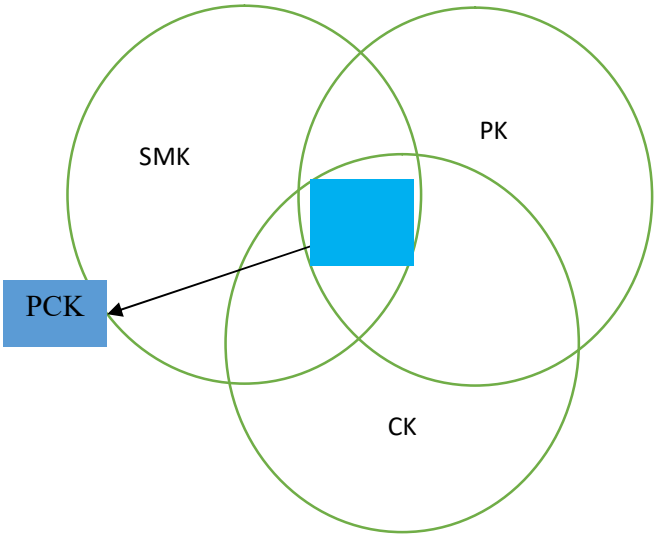


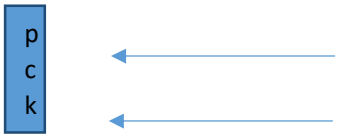
Fig. 1.3. Pedagogical content knowledge

Source: (Grees Newsome 1999)

Accordingly, kylic (2009) proposed another concept of PCK which is made up of four components. These are;

- Subject matter knowledge – Ability to recall facts and concepts.
- Knowledge of Pedagogy - Selection of teaching activities, tasks, examples etc. that are appropriate for their students.
- Knowledge of learners – refers to knowing students common challenges
- Knowledge of curriculum – relates to organization of learning experiences, textbooks, charts and manipulative.

Kylic concept of PCK is presented in Figure 1.4



Knowledge of subject matter	Facts, concepts and relationships between them
Knowledge of Pedagogy	Teaching and strategies
Knowledge of Learners	Students' common difficulties
Knowledge of curriculum	Learners Goals Instructional Materials

Figure 1.4: Components of Pedagogical Content Knowledge
Source: Kylic(2009)

Over the years there has been a lot of publications on the process of developing and integrating PCK into teacher education programmes in various subjects like Biology, (Grees-Newsome and Leaderman 1995), Chemistry (De Jong, Vandriel and Verloop, 2005), Physics (Halm and Meerah, 2002), Mathematics (Even , 1993) and Technology (Jones and Moreland, 2004).In addition, Halm and Merah (2002) identified the problem of the nature of pre-service teachers' content knowledge and they reiterated the urgency to focus more on PCK development rather than content knowledge. From the foregoing, it is evident that a lot of studies on PCK has been documented in literature, but most of themare foreign and they do not really address the teaching of Basic Science. Hence, there is a need to attempt an indigenous approach. That is one of the reasons why this research work is germane.

The Federal Government of Nigeriathrough the National Commisison for Colleges of Education has outlined a number of courses for developing the PCK of pre-service teachers. However, the usefulness of the proposed course to develop teachers' PCK is in doubt as observed by Sperander, Fazio and Torantino(2015)in

their study that the PCK of most pre-service teachers is low as they experience difficulty merging experiences gained from both content areas and education courses particularly when applying them in classroom situations. The major focus of carrying out a study on pre-service teachers PCK is to proffer solutions to the low level of PCK observed by many scholars and address the dilemma of whether PCK is topic specific or subject specific.It will also examine the challenges in the breaking of PCK into segmented sub-components by some scholarsas ifPCK is subject specific. However, in this study PCK is presented holistically as a single construct representing all forms of knowledge required for teaching.

According to Newborn (2001) there are limited number of scholarly work on the PCK of teachers of science in elementary schools., however these existing studies only address a few aspects of pedagogical content knowledge that emerge from classroom practices when teaching particular concepts. Furthermore, Usak (2005) suggested the development of undergraduate teachers PCK during collaborative microteaching exercises. This informs the use of group interactive strategy for the training of pre-service teachers on PCK in this study. However, otherefforts have been made towards the improvement of PCK of pre service teachers in science using other training methods. Juhier (2017) explored the use of lesson study and Content representation (CoRe) to develop their PCK, while Halm and Meral (2010) used the assistance of supervisors during micro-teaching exercises.This study explored the use of group interactive strategy to simulate the PCK during pair, peer and group interactions, particularly during micro teaching sessions. According to Ishkov(2015) Group interactive strategy has evolved as a result of efforts to increase learners' involvement in classroom activities, develop their interaction skills, provide students with leadership and decision making experiences and give them the chance to interact with peers from different culture and socio-economic backgrounds.

Many studies have reported the advantages of group interactive strategy. Eggien and Kauchak (2006) state that group interactive strategy help in solving problems by placing students in learning situations where group goals reward cooperation. John (2004) reported that students are more likely to collect and utilize data systematically working in groups than when working alone. However, there are conflicting reports on theimpactof group interactive strategy on pupils' learning outcome and teachers' pedagogy. For instance, Macgrefox (2011) states that group interactive strategy does not seem to enhance motivation and values unlike individual

learning which is explanatory in nature. Though this debate is inconclusive, group interactive strategy was adopted to boost the PCK of pre-service teachers and to see its effect on pupils' achievement in Basic science. It is hoped that as teachers' PCK improve, the achievementof students and theirattitude towards Basic Science can also improve.

Several forms of group interactive strategy have been proposed in literature; some of them are Student-Teams-Achievement-Division (STAD), (Slavin, 2015 and Chang, 2006,) Jigsawgroupings JG, Aronson (1978), Learning together,Johnson and Johnson, (1994). STAD is a group interactive strategy that uses multi-ability teams to teach facts, concepts and skills. Kauchak (2005) asserts that STAD involves a team of four or five students working towards the same goal. The STAD group interactive strategy is based on a four- step process as indicated in fig 2.

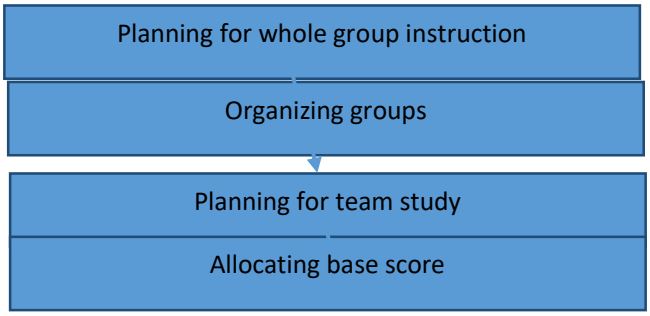


Fig 1.5: STAD Group Interactive strategy four- step process

Source: Kauchak (2005)

The choice of STAD as a group interactive strategy (GIS)in this study is premised on the report documented byGhaith (2002) and Cohen, Brody and Sapon-Sheola (2004) that STAD is more prominent, advantageous in breadth, highly applicable, handy and consistent with teaching philosophies and practices than other group interactive strategies.Although, Okebukola (1985,2002), Alebiosu (1998), Ojo (1992), Yusuf (2005) and Adeyemi (2002) have worked on the use of Group interactive strategy directly. The major focus of most of these scholars was that they compared the effectiveness of different forms of Group interactivestrategy on students' achievements in different disciplines such as Biology (Okebukola, 1985, 2002), Chemistry (Alebiosu, 1989), Sciences (Ojo, 1992) and Social Studies (Yusuf, 2005). In each of these studies, Group interactive strategy was found to have a greater effect on students' achievement. This study will exploit the advantages of group interactive strategy in developing the PCK of pre-service teacher.

Apart from the possible influence of pre-service teachers' PCK on their instructional delivery, there are indications that teachers' self-efficacy and experience can also influence their effective performance in the classroom. That is why many authorsGenova (2010) and Ormond (2006) have reported a linkage between teaching experience and PCK development.Self-efficacy is the perception that teachers claim about their competence as science instructors (Genova, 2010). According to Ormond (2006) self-efficacy is the personal conviction that one is able to accomplish a task with maximum success.

Teachers' self-efficacy has been found to doubt influence teachers' attitude and pupils' performance (Brower and Tomic, 2003; Herson, 2001; and Rose and Bruce 2007). The findings of their studies revealed that efficacious teachers enhance pupils' understanding, overcome fright and challenges. In addition, Tschannen, Moren and Hoy (2001) discovered that teachers with high efficacy demonstrate unique performances during instructional delivery, while Mousouhiden and Philipson (2005) also reported that as pupils acquire excellent higher self-efficacy, their performances also improve as a result of their involvement in challenging tasks. Scholarly works on self-efficacy have been recorded in various subject areas like Mathematics Alves (2016), Physics (Carkiroyh and Brone, 2005), Chemistry (Enoch, Smith and Hunk, 2000) but surprisingly not much studies have been centered on pupils' learning outcomesin Basic science. Therefore, the use of self-efficacy as a moderating variable in this study is to add to literature and to throw more light on the interactive effect of self-efficacy and PCK on pupils' achievement irrespective of the experience acquired by the teacher. .

Teachers' experience is a factor that influences teaching effectiveness apart from the teaching strategy that the teacher adopts. Most of the time, researchers focus on the experience of practicing teachers at the expense of the mode of entry of undergraduate teachers. The strong linkage between teachers' experience and the development of their PCK has been pointed out by many authors. According to Halm and Meerah (2002) the little or noexperience of some teachers explains why they usually express low level of PCK. In another study conducted by Mulholland and Wallace (2001), they found that teaching experience may not be a factor because PCK of teachers grow over time. This implies that it is after ateacher has gained the required confidence, mastery of subject matter, class control and some basic classroom pedagogy, that the development of PCK may manifest. Therefore, the

inclusion of teaching experience as a moderator variable in this study may increase the awareness of the need to explore the experiences gathered by pre-service teachers before gaining admission into training institutions and add to knowledge on the impact teaching experience plays on undergraduate teachers' PCK before and after training. It may also influence students' learning outcomes. The expectation is that as teachers acquire more teaching experiences their PCK development is boosted and pupils learning outcome in term of their attitude and achievement may be improved.

Many scholars have made substantial efforts towards improving achievement in and attitude to Science in primary schools. For instance, in the last two decades, there was a policy that suggested the use of children's first immediate language for science teaching, this idea suffered some setbacks (Fafunwa, Sokoya and Macaulaey, 1989). In addition the Federal Government of Nigeria (FGN, 2013) took a giant stride by identifying some institutions that would provide training for teachers for the award of different Professional Qualifications (NCE, B.A(Ed), B.Ed, Bsc (Ed), M(Ed), Dip (Ed). and PhD.

Although, these institutions were established to produce professional teachers, many questions can be raised about their operations such as, is there any yardstick for ensuring that the certificate obtained is comparable with performance displayed in and out of class? Is the period of pre-service training adequate for teacher trainees to acquire basic skills? Do their instructional deliveries improve students' learning outcomes in science? The field study carried out by the researcher in 2017 as well as that of Akinwunmi, (2006) indicate that the answers to these questions are exceedingly negative, specifically, Akinwunmi (2006) lamented the scrapping of teacher training colleges insisting that most teachers of this era lack the basic rudiments and ethics of teaching . Therefore, this study which addressed the training of undergraduate teachers to build up their PCK is very expedient and germane.

Studies like that of UNESCO, (2007), Adeoye, (2003) and Anderson, (2011) have identified that teachers' factor have an influence on students' learning outcomes in terms of achievement in and attitude to basic science particularly in primary schools. The need to inculcate scientific attitudes in primary school has been expressed by Okoruwa, (2004). That is one of the reasons why students' attitude is used as a variable in this study. Such attitudes like objectivity, open mindedness, logical thinking, critical thinking, and creativity are consistent with the objectives of

science teaching. It is the expectation of the investigator that PCK would elicit substantial changes in the attitude of students.

Reports have shown that many variables could mediate or influence pupils' leaning outcomes apart from teacher's factors or the strategy they adopt. Some of these variables are school climate and school size, (Stewart, 2009), family background factors (Ugwuja, 2010) and sex differences, (Sanchez and Wiley, 2010). Two of these factors used in this study are school location and self-efficacy (Herderson, 2000 and Lawrence, 2012). The choice of these two variables in this study is hinged on the submission of Ntibi and Edoho (2017) that they are more likely to influence students' learning outcomes than other variables. Ntibi and Edoho, (2017) refer to school location as a place (rural or urban) where the school is situated. In this research work, Ogun State public primary schools were grouped into rural and urban schools. Most studies have indicated that pupils from urban primary schools outperformed their cohorts from rural primary schools in term of achievement (Abdul Hamid, 2012, Kachero, 2014). Contrary to this position, Ruthwonski (2003) claimed that the location of school students which attend is not a contributory factor to students' performance in science. Similarly, findings from some studies conducted by Ntibi and Edoho(2017), Yusuf and Adigun (2010) and Bosede (2012) showed that the environment of a school does not have any impact on students' learning outcome in science. However, in other instances, findings from Owoeye and Yara, (2011), Ella andIta(2017) showed that where the school is situatedcontributed immensely to the achievement in and attitude of pupils to science. Based on the contradiction of findings of scholars, school location was incorporated as a moderator variable.

Also, studies from various scholarsWitt-Rose (2003) and Zimmerman (2000) have generated inconclusive debates on the achievement of pupils as influenced by their self-efficacy. It was the conclusion of these scholarsthat pupil's self-efficacy can mediate students learning outcome apart from the teaching strategy. Bandura (1997)referred to pupils' self-efficacy as the confidence they demonstrate in performing a particular task successfully. Zimmerman, (2000) submitted that pupils' self-efficacy belief has been found to enhance variance in students' cognitive development. In addition, studies from Debacker and Nelson, (2000) showed that there exist a positive correlation as a result of their involvement in challenging tasks. Contrary to these findings, Chang and Westwood, (2007)did not observe anyrelationship between self-efficacy and pupils' performance. Hence, it appears

there is no consensus on the interaction effect of pupils' self-efficacy and school location on the achievement in and attitude of students to Basic Science, particularly in primary schools. This informs the use of school location and pupils' self-efficacy as moderator variables in this study.

Therefore, the expediency to train pre-service teachers on PCK in order to enhance pupils' performance in science is the crux of this study. This is in line with the resolution of a PCK summit held by a group of science educators from which Rollink and Mavhunga (2015) reported that the next objective for their group was to find ways of linking good teachers PCK to students' outcome, select teachers who have high scores on PCK instruments, and observe them using the target topic, testing their students before and after teaching. That is exactly what this study achieved with pre- service teachers from the department of Primary Education. The choice of pre-service teachers for this study was premised on the fact that they would form the bedrock of future primary school teachers committed to effective teaching of science in the next generation. The expectation is that well-trained teachers would make desired learning outcomes realisable in Basic Science in primary schools and by proxy, remedy the observed under achievement and negative attitude of students towards science disciplines in primary schools and beyond.

1.2 Statement of problem

At present, teachers have a greater responsibility than ever before to help the students develop appropriate learning patterns and achieve desired outcomes in science in primary schools. Efforts have been made by government, schools and other agencies towards ensuring that scientific attitude, skills and knowledge of science concepts are inculcated in pupils' right from primary schools by exposing them to qualitative Science teaching. These efforts include curricular reviews, exposing teachers to new teaching strategies and skills development through regular workshops, providing funds for purchase of instructional materials or encouraging the use of science kits. But in spite of these efforts, students learning outcomes remains relatively on the average as majority of them could not meet the basic prerequisite to further their studies in science discipline indicating that the objectives of basic science as stated in the primary school curriculum still need to be improved upon. Majority of previous studies focused on the use of different strategies to teach students directly and the mastery of content knowledge. However, most of the studies did not

emphasize the training of pre-service teachers on the use of this strategy particularly with their PCK as a focus. Although, the training teacher trainees on PCK have been found effective in the areas of Physics, Chemistry, Biology and Mathematics, not much literature has been documented in the training of Primary Education Department (PED) pre-service teachers who are potential specialist in primary schools. In this study PED pre-service teachers were trained on their PCK and the effect of this training was determined on the learning outcome of pupils in basic science. The moderating effect of self-efficacy and school location were also considered.

1.3 Research Questions

1. Is there any difference in the pedagogical content knowledge (PCK) of pre-service teachers before and after exposure to training with group interactive strategy?
2. Is there any difference in how pre-service teachers rate their self-efficacy before and after training with group interactive strategy?

1.4 Hypotheses

The study tested the following null hypotheses at 0.05 alpha level.

Ho_1: There is no significant main effect of treatment on pupils'
- (i) Achievement in basic science in primary schools
- (ii) Attitude to basic science in primary schools

Ho_2: There is no significant main effect of teachers' self- efficacy on pupils'
- (i) Achievement in basic science in primary schools
- (ii) Attitude to basic science in primary schools

Ho_3: There is no significant main effect of school location on pupils'
- (i) Achievement in basic science in primary schools
- (ii) Attitude to basic science in primary schools

Ho_4: There is no significant interaction effect of treatment and self-efficacy on pupils'
- (i) Achievement in basic science in primary schools
- (ii) Attitude to basic science in primary schools

Ho_5: There is no significant interaction effect of treatment and school type on pupils'

(i) Achievement in basic science in primary schools

(ii) Attitude to basic science in primary schools

Ho_6: There is no significant interaction effect of self-efficacy and school type on pupils'

(i) Achievement in basic science in primary schools

(ii) Attitude to basic science in primary schools

$Ho_{7:}$ There is no significant interaction effect of treatment, self-efficacy and school type on pupils'

(i) Achievement in basic science in primary schools

(ii) Attitude to basic science in primary schools

1.5 Scope of Study

The research focused on the training of Primary Education Department (PED) students from Colleges of Education in Ogun State on their pedagogical content knowledge (PCK) using group interactive strategy (Student Teams Achievement Division, STAD). It examined the impact of this training on pre-service teachers' (PCK) and teachers' self-efficacy and how this impactedon the achievement and attitude of primary six pupils in selected schools from urban and rural schools in Ogun state. Three basic science concepts of Air, force and human blood circulation were the focus of this study.

1.6 Significance of the study

It is anticipated that the findings of the study would provide guidelines on the training of pre-service teachers (PST) for the teaching and learning of Basic Sciences in Primary school. The study is expected to show the efficacy or otherwise of the use of Group interactive strategy for the training of pre-service teachers' on PCK in primary schools. Expectedly, the findings of the study would provide teacher trainers with adequate technical know- how and equip them with the basic skills on the use of group interactive strategy to train PST on PCK.

Furthermore, the findings of this study would provide adequate information on ways of capturing and developing teachers' PCK and teachers' self-efficacy. Also, the findings would promote practical engagement and extend the teachers' frontiers of knowledge on the use of group interactive strategy inbasic science classrooms. It would make students understand basic science in primary school and solve the

recurring issues of under achievement and negative attitude towards science disciplines.

The study would add to the existing literature on STAD Group interactive strategy especially as it relates to the training of pre-service teachers' on PCK and findings would definitely spur up further researches in Basic science teaching. Finally, it would provide adequate information to authors of textbooks, curriculum planners, school administrators, inspectorate divisions of the Ministry of Education and researchers on the modern trend in the training of pre-service teachers.

1.7 Operational Definition of Terms

Pedagogical Content Knowledge (PCK): it is the combination of content knowledge and pedagogical knowledge essential for the teaching of students based on their individual and group abilities as measured through PCK scale.

Teachers' self -efficacy: is the belief in one's capabilities to organize and execute actions in an appropriate and effective manner to attain certain goals. It is measured through teachers self-efficacy scale.

Group interactive Strategy: It is a strategy that provides roles for students to work together while emphasizing social interactions. In this study, Student Team Achievement Division (STAD) Group interactive strategy was adopted.

STAD : It is a form of group interactive strategy that uses multi-ability teams to teach facts, concepts and skills. STAD and Group interactive strategy are used interchangeably in the context of this study.

Learning Outcomes: These are the achievement and attitudes of students.

Students' Attitude: This refers to the interest and willingness students have towards science.

Pre-service teachers' teaching experience: This is the number of years acquired by PST before gaining admission in to the college or university. They are measured and classified in to experienced (high) and inexperienced (low) through demographic information and interviews

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CHAPTER TWO

REVIEW OF LITERATURE

Literature for this study was reviewed under the following sub-headings:

2.1 Theoretical Background

The theoretical Framework draws from two bodies of literature

1. Socio-cultural Theory
2. Social Cognitive Learning Theory

2.1.1 Socio-cultural Theory

The major framework for was proposed by Vygotsky (1896-1934) Social cultural theory contends that children cognitive development manifestswhen children engage in social relationship with peers and capable adult. The theory suggests that

learning occur through interactions, negotiation and collaboration as accomplished by **Zone of proximal development (ZPD).** It is within the scope of ZPD that social interaction affects cognitive growth. According to Vygotsky ZPD is the gap separating the present and potential development levels. He explained that present development would later metamorphose into potential development and the sequence goes on in that order.

Furthermore, according to Socio-cultural theory of **'Dynamic Assessment**' (DA) describessome activitiesthat influence learners' desire to improve. In addition, dynamic assessment is concerned with how assistance could help a child to perform better and how individuals who earned the same score in a given task achieved that score. This suggests that DA is the ability of a child to excel in a domain with or without assistance. This theory also views leaning as the process of **"enculturation"** in which the goals of institution is to organize some engagements within the confines of students' immediate environment. Given the comprehensive nature of Socio-cultural theory, the implication of this theory to the study is broad. The ZPD emphasized in the theory that children's cognitive development occur through a transition from resent development to potential development implies that PCK can be improved upon by harmonizing or bridging their varying knowledge bases essentially through group activities.

Moreover, the Social interaction, guided participation and enculturation factors embedded in socio cultural theory are also exemplified in group interactive strategies. Based on this premise, students work in group with capable peers and elders such that some tasks they were able to do when working in group could also be accomplished independently without assistance. In addition, based on Socio cultural theory, the goal of education assessment should be dynamic and achievable. Hence, pupils' achievement and potentials that are capable of improving should be identified and assisted to attain maximum growth with peers. This is applicable to the process of identifying their level of self-efficacy and training them to make pre-service teachers more efficacious in their pedagogy.

2.1.2 Social Cognitive Learning theory (SCLT)

SCLT strongly influenced by Bandura (1997) highlighted the idea that **learning occurs in the social environment**. The theory suggests through observation and imitation of peers, one can acquire knowledge of values. Social cognitive learning

theory (SCLT) defines **learning as an internal mental activities** that may lead to a subtle change in behavior. SCLT is based on the following assumptions.

1. Students learn by observing others.
2. Learning is internal.
3. Learning is goal-directed.
4. The person, the behaviour and the environment all inseparably work together to create learning in an individual.

The SCLT is related to this investigationin that the use of STAD reflects students working together in a social environment, observing each other and focusing on desired goals. In line with the perspectives of SCLT that persistent interrelationship between the individual and the environment can enhance learning.interaction between the individual, the behaviour and the environment influence learning. The use of teacher's and pupil's self-efficacy as variables make teachers and pupils to develop intrinsically the ability to appreciate difficult tasks that can be solved through observation of others , set challenging goals and have commitment towards achieving the goals as outlined by Bandura.

2.1.3 Appraisal of Literature

The resume of literature revealed the underachievement of students and the low PCK of most pre-service teachers. Although researchers have identified the training of pre-service teachers as a *sine-quanon* to solving this problem. Scholarly research work on the training on Pre-service teacher's PCK in Basic science is scanty. The expediency for an improved Pedagogical Content Knowledge (PCK), and self-efficacy of teachers was established towards making pre-service teachers effective and efficient in their teaching and consequently, enhancing the understanding of Basic Science in primary schools. The current trend of teachers' self-efficacy and experience were established and the position of the authors is that these can be improved over time through workshops and capacity building of in-service teachers and the training of pre-service teachers. Unfortunately, of all the researches on Group interactive strategies under review, very few investigations were tailored towards Basic Science, the emphasis has been on Physics, Chemistry, Biology and Mathematics. Succinctly, creating a gap to be filled in the area of studies on Basic Science in Primary schools especially with STAD and Competitive strategies impacting on pupils' learning outcomes.

2.2 Conceptual Review

2.2.1 Nature and Objectives of Teaching Sciencein Primary Schools

Science is a way of investigating and appreciating the natural and physical environment. Scientific investigations are systematic, organized and logical ways of testing hypotheses towards arriving at truth and verifiable facts.Science teaching entails the inculcation of science education and scientific literacy into children such that they can be able to distinguish between theories and laws which have been supported by empirical evidences and speculations/superstitious beliefs which have no basis and scientific backings.

Science comprises the epistemology, process and product. Epistemology is the knowledge acquired from science teaching whileprocesses of science are procedures used in carrying out investigations such as asking questions, postulating hypotheses, carrying out experiment, observing, recording, interpreting data, generalizing and theorizing. The products of science are the outcome of investigations after exploring the science processes as guided by the curriculum.

The Basic science Curriculum for basic education 1-9 emphasized the interpretation of the content there-in, that is why the content organisaton is thematic in nature and each theme is integrated in a unifying manner. The themes outlined for the science teaching in primary schools are vertically and horizontally integrated.Science teaching is expected to be presented as a process of inquiry where students are encouraged to actively involved. A good strategy highly recommended for science teaching at the lower basic education is Group interactive strategy. Science teaching in primary schools are targeted at developing the intellectual, attitudinal and manipulative skills of the students. Hence, interactive and child-centered teaching are expected to be presented by highly qualified and well- trained teachers with an in-built of mechanism for determining learning effectiveness or assessing the attainment of set objectives.

At primary level, a number of psychological and behavioral theories should drive the teachers' choice of instructions when teaching science.These theories includes that of Pavlov, Skinner and Thorndike.For instance the notion that science teaching should integrate motivational factors as proposed by the Stimulus-Responses(S-R) theory of Pavlov could provide underlying assumptions by teachers to enable learners sustain the desired interest and develop their potentials in science classrooms.

Some of the reasons why science teaching is important in primary schools are;

- To develop pupils interest in finding out about their physical and natural environment,
- To develop the potential scientific process skills of pupils such as objectivity, open-minded and creativity.
- At this early stage of the pupils' life, they are curious about life, therefore science teaching aims at developing the intellectual and manipulative skills of pupils.
- Scientific teaching in primary schools also aims at preparing the pupils for future careers and opportunities in science disciplines and
- To develop pupils attitude towards science.

2.2.2 Pedagogical Content Knowledge (PCK)

PCK is prominent in the preparation of teachers and finding a lasting solution to the problems associated with teachers' knowledge base. In the past, teacher preparation essentially make use of content knowledge which emphasizes the mastery of topics by teachers without taking cognisance of contextual implication of abilities of students to learn. Shulman (1987) identified PCK as the ideal type of knowledge on which effective science teaching is based. PCK is the integration of content knowledge with general pedagogy. Subsequently, many scholars have conceptualised (PCK) differently using Shulman's model as a baseline. Subsequently, some elements of teaching such as knowledge of curriculum and assessment have been added to Shluman's proposition of (PCK). In another vein Vandriel (2011) presented pedagogical content knowledge in such a way that different components interact together. These components include teachers' attitude towards teaching, teachers' mastery of scientific concepts, teachers' teaching strategies/teaching methods and assessment in science teaching. The belief of many science scholars is that they are expected to build up their (PCK) to expertise level to enhance optimum instructional delivery as science teachers. Additionally, Lougham (2000) articulated (PCK) contextually bycombining 'CoRe' and 'PaP-eRs'. Lougham identified (CoRe) as a group of questions and ideas that make up Shulman's knowledge base of a particular topic while the (PaP-eR) relates to individual teacher's idea of teaching a particular

topic, therefore for proper articulation of a teachers (PCK), each (CORe) is linked to a group of (PaP-eRs) of individual teachers in a particular topic.

PCK Development

Several authors have observed negative correlation between subject matter knowledge and individual teacher's PCK. By implication it appears from various studies that improved subject matter knowledge does not automatically translate into effective PCK development. In addition, Magnusson (1999) in his study observed that all components of PCK cannot be addressed in a teacher education programme. Magnusson posited that PCK development is supposed to be an important and integral part of teacher training. Relatedly, Appleton (2003) carried out a study using the beginning Basic science teachers and found out that equipping them with hands-on activities help the teachers to stimulate and develop their PCK.

2.2.3 Pre-service Teachers' Education

Pre-service teachers are teachers undergoing different types of training in institutions of higher learning designated to train teachers. These institutions include colleges of education, department of education in polytechnics and university. Some are private, public or specialized institute of education. After completing a pre-service teacher training, participants are awarded different certificates ranging from Nigerian Certificate in Education (NCE) which is the minimum standard before they can be employed. Other certificate obtained by teachers are Bachelor of Education (B.Ed) or Bachelor of Science education (B.Sc Ed). These qualifications are necessary to enable them register for the professional cadre of teachers known as Teachers' Registration Council of Nigeria (TRCN).

Pre-service teachers training provides a necessary impetus for the acquisition of ethics essential for effective teaching. Teachers vary from one category to another, subject specific teachers are trained and expected to teach various subjects like biology, physics, chemistry etc. The other category of teachers are mainly general studies department one of which is the Primary Education Department (PED) whose objective is to train hem to handle the subjects outlined in the basic 1-6 curriculum. This curriculum include subjects like Primary Mathematics, Science, Social studies, Cultural and Creative Art, Nigeria Languages, Physical and Health Education (PHE), English Studies, Computer Studies and Arabic language.

The mode of teaching recommended in basic 1-6 curriculum is learner-centered approach. The traininghelps to develop teacher trainees to be able to prepare scheme of work, lesson plan and acquire teaching skills. Each training programme required for the award of teachers' certificate consists of general study, knowledge of English, education and two teaching subjects in case of subject- based programmes. Double major courses like Primary Education Department (PED) requires only one double major subject. However the curriculum is packaged in such a way that these knowledge bases are taught separately in different departments making it almost difficult to articulate these separate structures to meet the required knowledge base for teachers. This has made it very imperative to carry out studies on the development of PCK and determine its effect on the learning outcome of pupils.

2.2.4 Group Interactive Strategy

Group interactive strategyis a collaborative approach that emphasizes pupils working together for the same target or common goal. This strategy has evolved to make learners actively participate and interact among their mates in the teaching and learning process irrespective of their race, sex or creed. Five elements make up an effective Group interactive strategy. These elements make it possible for students to set a goal and collectively achieve the goal.

In group interactive strategy pupils are arranged in groups of at least five pupils per group, the teacher asks each group to solve a problem using a worksheet as a guide until everyone in the group knows the answer. Each question given to a group is answered by the peer by comparing the answers. When the peer can resolve the disagreement they continue, if they can't resolve the disagreement they confer with the other peer in their group comparing and discussing their answer with the other peer. The teacher intervenes only when disagreement among the four students in the team cannot be resolved. Rather than having students working independently before checking answers, team mates consult themselves. Students are required to put their pens or pencils down until the group discusses each question which is read by one member of the group. Once agreement is reached, students write down their answers then a second member of the group asks the next question. The need for dialogue before students write down their answers provides greater opportunities for cooperation and sharing.

There are several types of group interactive strategies in literature.

These include:

Student Teams Achievement Division (STAD) group interactive strategy, competitive and individualistic strategies. However, STAD group interactive strategy adopted in this study is designed to teach facts, concepts and organize bodies of knowledge in group. However, the most important features of group interactive strategy are:

1. **Planning for a whole group instruction:** According to Slavin (1995) the first thing required for an effective implementation of STAD group interactive strategy is to plan for a whole group instruction by getting the students and materials readily available and preparing the mind of the students for the task ahead.
2. **Organizing group**: Slavin (1995) suggested that four students is an ideal number of members for a group but groups of five members can also be used effectively. One way to ensure that groups are similar in their range of abilities involve ranking the students, dividing them into quartiles, and assigning one student from each quartile to each group. Student ranking may be based on previous recorded continuous assessment scores.
3. **Grouping Students:**Each participating cluster is identified and arranged as illustrated in figure II. With a sample class of 25 students (using hypothetical alphabet or letters A to Y), an effective way of grouping students is to arrange them according to their performance and place them in quartiles as shown in figure II. The first group will then include AGSY and the second group will be BJR and X, the sixth group having five members because of the number of people in the class (25) will then be FLNT and M.

STUDENT/QUARTILE

A	**G**	N	T
B	H	O	U
C	I	P	V
D	J	Q	W
E	K	R	X
F	L	**S**	**Y**
	M		

GROUP		**CONSTITUENTS**
I	-	A, G, S, Y
II	-	B, H, R, X
III	-	C, I, Q, W
IV	-	D, J, P, V
V	-	E, K, O, U
VI	-	F, L, N, T, & M

Figure 2.1 - Arrangement of students in quartiles

After initially forming the groups the teacher should check there makeup to ensure they are balance by the ratio of boys to girls.

4. **Planning for Team Study:** The success of STAD, learning teams depends on having high quality materials to guide the interactions within groups. As teachers plan their lessons, they need to ask themselves, "What specific concepts or skills are students learning and how can I design materials that will allow them to learn effectively in their groups?" This is where clearly specified learning objectives are important. The team study materials should require convergent answers that are clearly right or wrong. If the content doesn't lend itself to convergent answers, STAD group interactive strategy is not the most effective model to use.

5. **Calculating Base Scores and Improvement points:** The teacher determines students' base scores (in the context of this study, scores of students in Basic Science Continuous assessment test earlier obtained before the commencement of the study was adopted as their base scores. Improvement points are calculated as the difference between the post test and Base scores. Therefore, if a student has a base score of 50 and scores 70 after treatment. The calculation of improvement point is indicated in fig. 3. Improvement

points are calculated as the difference between the post test and base scores. Illustration using 4 pseudo names in a group; Ade,Tola, Kunmi and Bolu

Students	Base score	Posttest	Improvement point
Ade	50	**50**(≤ 50)	zero
Tola	50	**53**(51 – 55)	ten
Kunmi	50	**59**(56 – 60)	twenty
Bolu	50	**63**(> 60)	thirty

Fig. 2.2:Calculating improvement point

Based on the process of awarding improvement points, Tola would receive ten improvement point. In comparison, Kunmi would receive twenty improvement points because his quiz score was nine points above his base score and Bolu would receive thirty points because her posttest score was more than ten points above her base score. This equal opportunity for success can be a powerful motivator when STAD group interactive strategy is used.

Team Awards: This is calculated by finding the mean of improvement points before each team is given an award.

2.2.5 The Concept of Teachers' Self efficacy

Ormond(2006) refers to self- efficacy as the capability of an individual to accomplish a task towards achieving a particular target. In educational parlance teachers' self- efficacy is the personal conviction of a teacher to organise teaching processes purposively to make students lean appropriately. In most cases, teachers' self- efficacy are interpreted as the mastery of content of teachers. The fact remains that the two concepts are interrelated. For instance, a teacher with high self -efficacy would exhibit high level of mastery of content while a low efficacious teacher would likely have a low level of mastery of content and skills of teaching. These concept of self -efficacy is a mechanism for regulating teachers competence in teaching and enhancing the positive learning outcome of students.

The social cognitive learning theory SCLT proposed by Bandura was the driving force of Teachers' self-efficacy. Bandura (1997) chronicled it as the perception of a teacher about his ability to plan and accomplish a task successfully. He divided self- efficacy into two, these are efficacy and outcome

expectancies.According to Bandura, the efficacy expectancy is the confidence a teacher has in organising classroom experiences successfully while the outcome expectancy is the consequence of the action the teacher has taken after accomplishing the task.The position of Bandura is that both components must be acquired by a teacher for attaining high level of self -efficacy.Another major aspect of Bandura's theory that can enhance high self- efficacy is the ability of teachers to demonstrate competence in their pedagogy. According to Bandura, teachers with high self-efficacy achieve resounding success in their teaching while the reverse is the case for teachers with low self- efficacy. Also, Bandura admonishes teachers to learn from the success of other teachers. Teachers need to observe them and be ready to learn from them in order to build up their own confidence and capabilities.

Additionally, a good teacher is supposed to be in a good state of mind, free of stress and anxiety. According to Bandura, even a teacher who is professionally qualified may exhibit low self-efficacy if he/she is emotionally unbalanced. Hence a teacher who is always depressed, cruel and wicked may not achieve desired learning accomplishment because his confidence towards giving his best and attaining high level of self -efficacy might have been disillusioned.

The relationship between self- efficacy and students' learning outcome has been investigated by many authors. The conclusion is that teachers with high self-efficacy take more risks, overcome challenges and give their best in classroom situations because they are friendly and highly committed to achieving desired learning outcomes of students(Tschanmen –Moran and Hoy, 2001)

2.3 Empirical Review

2.3.1 Group interactive strategy and PCKof Pre-service teachers

Kylic (2009) carried out an investigation on the Mathematical content knowledge, he found out that most of them have low PCK when they use Group Interactive Strategy for teaching mathematics.

The consensus that only content knowledge is ideal for a good teacher has propelled an investigation into the actual knowledge base and skills are required for effective teaching and enhance better understanding. Mark (1990) investigated the component of PCK by conducting interviews to Elementary Science teachers when using Group Interactive Strategy and found it to have significant effect in their PCK.Kinach (2002) also investigated the impact GIS has on the PCK of teachers in

the subject and reported that teachers improved after exposure to training with Group interactive strategy in addition and subtraction of integers. They also observed that there were changes in the PCK after taking a course in Group interactive strategy.

However, Newborn(2017) investigated the improvement in Pre-service teachers PCK in elementary science curriculum courses in classroom delivery, choice of teaching strategies and class control. The researcher found out that the training revealed that worksheets and resources substantially benefitted the students.

Latterel and Carmen (2005)carried out a correlational study between co-teachers and co-discipline in group interactive collaborative studies. They found out a negative correlation between co-teachers and co-discipline in that circumstance, developing PSTs' PCK was very difficult.

Furthermore, Agyei and Vogt (2012)investigated the use of Group interactive strategy in enhancing the development of the PCK of undergraduate teachers.Their findings suggested that more efforts are required to effectively develop their PCK.

Luechman (2007) investigated how to boost the various the constituents of PCKwith Group interactive strategy. His findings showed that methodology and subject matter developed but understanding students' misconception remained unchanged after a period of time, He therefore suggested that the training of PCK using Group interactive strategy could enhance their performance during instructional delivery.

2.3.2 Student Team Achievement Division(STAD) Group Interactive Strategy and Pupils Achievement

Scholarly research works on the effect of STAD Group interactive study on pupils' achievement are numerous. The study conducted by Olatoye, Aderogba and Aanu (2012) on the effect of Group interactive strategy in Chemistry revealed that STAD Group interactive and individualized teaching strategies significantly improved students achievement in organic chemistry. (Ghaziand Owodunni 2001; Inamullah 2005; Wilkam, 2014) worked on the effectiveness, achievability and practicability of STAD as an instructional strategy on achievement and their findings showed that STAD has not been effectively used particularly in science discipline. In addition, Owodunni (2015) investigated how classroom interaction STAD can influence students' performance in Electricity and that classroom interaction significantly influenced students' performance in the subject.

Njoroge and Githms (2013) conducted a research on STAD and learners' mathematics achievement. Findings show that gender differences have no place on students' performance. They recommended the integration of STAD group interactive strategy in teacher education programme. Furthermore, Muraya collaborated with Kimamo (2011) to x-ray the impact STAD has on Biology students' performance in Kenya, they observed that STAD enhanced the performance of students. Also, Vandom Tram (2014) carried out a study on cooperative learning and retention of knowledge in science showed a significant effect. William (2014) examined STAD strategy and pupils' achievement, his findings indicate that STAD E-learning enhanceachievement. In a related development, Li-Yung and Meng (2015) used interactive projector as group interactive teaching tool in the classroom. He observed that students' performance was not enhanced when projector was used. He suggested that integration of interactive technologies in the classroom might not ensure better learning performance or teaching efficiency. A study conducted by Bidesanmi and Oludipe (2010) on the effect of STAD group interactive on students' learning outcome in science discipline revealed a negative trend in immediate cognitive and affective performance.

Iroha (2012) studied the impact of interaction patterns on pupils learning outcome in science He involved 15 selected science teachers and the result show that classroom interaction patterns was influenced by the participants.

2.3.3 STAD Group interactive strategy and pupils' attitude to science

Some empirical studies on the effect of STAD group interactive strategy on pupils' attitude to science have shown significant effect of GIS on attitude of students to science. For instance Campo (2015) investigated the effectiveness of STAD group interactive strategy on students' attitude towards science. The researcher used a Quasi pretest-posttest experimental design and the findings revealed that the attitude of those in the treatment group significantly improved after exposure to STAD group interactive strategy.

Relatedly, Akinsola and Ifamuyiwa (2008) studied the influence STAD has on students attitude on the STAD group and the result was plausible. In addition, another empirical study documented in literature is the work of Adesoji and Ibrahim (2011) when they investigated the effect of STAD strategy and mathematics knowledge of senior secondary school student on learning outcome in chemical kinetics. Findings

showed that students' attitude were significantly enhanced by exposing them to STAD cooperative strategy. Also, Edoja and Musa (2010) studied Jig-saw asa teaching strategyon SSS attitude to Biology. Results of this study showed a positive attitude. Zakaris,, Chin and David (2010) investigated the effect of STAD strategy on attitude to science. Findings from that work revealed that STAD strategy significantly enhanced students' attitude towards mathematics and science.

2.3.4 Teachers' self-efficacy and pupils' achievement in Science

Yusuf (2005) investigated whether self-efficacy has any contribution to the way pupils perform, the result revealed that self-efficacy beliefs enhanced pupils 'performances. Relatedly, a survey method used by Meral, Colak and Zerayak (2012) examined the correlation between self-efficacy and pupils' post-test mean scores Findings show that self- and pupils' post mean scores were positively related.

Furthermore, Witt-Rose (2003) studied the dimension of teacher's self-efficacy and selected science students'achievement . The result showed that self-efficacy of teachers enhanced pupils' achievement in science discipline. Debacker and Nelson (2001) investigated the composite and relative effect of efficacy and motivation on pupils' performance in science. Reports showed that these factors positively enhanced and could predict students' performances.

In addition Shahzad, Mohammed, Hurthman and Hossein (2011) studied self-efficacy and its impact on the performance of science students. In the study, 250 students were selected by means of multistage cluster sampling and data analysis was done by regression analysis. Finding revealed that self-efficacy determinant of students' achievement.

2.3.5 Teachers' self-efficacy and pupils' attitude towards science

Self-efficacy is the self-judgment about his/her capacity to manage and plan the required activities so as to develop himself/herself. Evaluating the impact of self-efficacy on attitude towards science in a non- major college course using attitude towards science inventory, Schruba (2008) found out that self-efficacy of teachers influenced students' attitude towards science.

Furthermore, Uitho (2010) investigated the relationship between attitudes and self-efficacy while exploring science pupils some courses. Findings revealed that pupils' attitude were significant.

Edem (2015) conducted a research on self-efficacy and attitude, he found out that the relationship was positive. In another study, Herson (2001) found out that self-efficacy beliefs are essential for enhancing more positive to science. He also reportedthat students' attitude wereaffected by their self-efficacy. Furthermore, Onuka (2015) examined self-efficacy and attitude towards science teaching using a conceptual model and found out that attitude towards science was linked positively to their self-efficacy.

2.3.6 Teachers' experience and pupils' achievement in science

Several studies related to teaching experience and pupils' achievement in science have been documented in literature. Rice (2010) investigated the impact of teaching experience in Urban institute students using an empirical study to test two research questions. . His result showed that teachers' experience positively correlated with pupils' achievement as pupils taught with more experienced teachers excelled than their cohorts taught by teachers with little or no experience than their cohorts taught with inexperienced teachers.

In addition, Rockoff (2003) worked on the impact of individual teachers' experience on achievement and found a large and statistically significant difference among teachers' quality and students' achievement in mathematics and reading. Abdullah (2012) examined teacher effectiveness and experience on achievement in mathematics using multiple regression analytical tool. Result obtained showed that apart from teachers' qualification, all other variables like teachers' experience and teachers' effectiveness predicted the dependent measures.

Harris and Sass (2014) investigated the relationship between Teacher training and Teacher quality on students' achievement and they found a positive relationship. Another study carried out by Boyd (2008) on Teacher gratification and its implication for students' performances observed that students exposed to experienced teachers outperformed their cohort handled by inexperienced tutors.

2.3.7 Teachers' experience and pupils' attitude to science

There are various studies on the effect of teachers' experience and pupils' attitude to Science. Karr (2011) investigated the attitude of students towards years of experience, he observed that there was a remarkable effect of pupils' attitudes when taught by teachers of varying teaching experiences.

In a related study, Blazar (2011) investigated the impact of accrued early years of teaching experience on the attitude of students toward literary learning. Result obtained revealed a substantial impact of teaching experience and students' attitude. Furthermore, Adesina (2016) found a significant positive attitude of students towards teaching profession.

2.3.8 School location and pupils' achievement in science

The issue of school location affect pupils' achievement in a variety of ways. School type could come in different forms such as public/private, single/coeducational, rural/ urban and boarding/day schools. Alim ,Ehinola and Alabi (2012) examined the impact of school location and facilities on students' achievement in Basic science. They found that rural and urban pupils performed at different rates. Alim etal observed that pupils from urban locations improved when juxtaposed with the performance of their colleagues in rural settings. A similar result was found by Howley (2003) when he studied the impact of school type on students' achievement of JSS students in Basic science.

However, Craig (2010) worked on the effect of type of school attended and achievement and the result obtained indicate that certain school type are better and they improve students achievement than others in Basic science. However, Osalusi (2009) carried out an investigation into the effectiveness of school location on achievement focusing on private high school of South Korea. He found variance in their posttest mean scores . However, Bosede (2010) did not find any difference in achievement of students who attended rural and urban schools

2.3.9 School location and pupils' attitude in science

Research work on school location has attracted many scholars. Iliyasu, Lee and Yahya (2005) carried out a study on the attitude of as affected by school location. Revelations of this study show that students from public schools have more positive attitude than theircounterparts from rural schools. In related studies, Hu (2003) x-rayed the impact of school location on students' attitude at the secondary school level and he found out that there was high difference of confidence studying mathematics in schools located in the cities than in rural environment, basing his argument on the challenges facing rural schools that can lead to negative interest of students Furthermore, Owoeye (2000) conducted a study on the attitude of students inscience

according to their type of school found significant difference in attitude of students in small and large classes from urban schools. However, Hussaini, Kama and Foung (2015) investigatedthe attitude of pupils towards science found significant differences in the attitude of urban and rural pupils.

2.3.10 Appraisal of Literature

The resume of literature revealed the underachievement of students and that the PCK of most pre-service teachers is drastically low. Although researchers have identified training of pre-service teachers on PCK as one of the solutions to solving this problem. Scholarly research work of Pre-service teachers on PCK is scanty. The expediency for an improvedPCK, and self-efficacy were established towards making pre-service teachers effective and efficient in their teaching and consequently, enhancing the understanding of Basic Science in primary schools.

The current trend of teachers' self-efficacy and experience were established and the position of the authors is that these can be improved over time through workshops and capacity building. Unfortunately, of all the researches under review, very few investigations were tailored towards Basic Science, the emphasis is on Physics, Chemistry, Biology and Mathematics. Succinctly, creating a gap to be filled in the area of studies on Basic Science in Primary schools especially in social cognitive and socio-cultural learning philosophies.

CHAPTER THREE
METHODOLOGY

The main objective of this chapter is to describe the research design for the study and selection of participants. It will also outline the instruments that was used for the study and research procedure. Finally, the chapter describes the method of data collection and analysis.

3.1 Research Design

This study adopted the mixed method design. The first stage wasboth a qualitative and a quantitative study while the second stage was a quantitative study. The study commenced with a surveyand dovetailed into an experimental research (quantitative). The qualitative study adopted a Phenomenological approach while the quantitative study adopted the pretest-posttest, control group quasi-experimental research design which involved the group interactive strategy and the conventional strategy groups.

Stage 1: This is the qualitative and quantitative aspects of the study which involved the assessment and documentation of pre-service teachers' PCK and self-efficacybefore and after training with Group interactive strategy. This was essential for the selection of participants for the second phase of the study. Pre-service teachers in the treatment group with relatively high PCK (65.0% and above) and teachers' self-efficacy as determined through appropriate instruments including microteaching exercises along with their cohort in the conventional group were randomly selected.**Stage 2:** This is the quantitative aspect of the study. Selected participant from stage1(trained and untrained) carried out the teaching of primary school pupils in basic science after assigning them to treatment and control groups.

The design study of stage 2 is represented as

O_1 X_1 O_3 Experimental Group

O_2 X_2 O_4 Control Group

Where O_1andO_2 represent the pretest for the experimental and control groups respectively, while $O_3$and O_4 represent the posttest for the experimental and control groups respectively.

X_1 - Groupinteractivestrategy

X_2 - Conventional

Table 3.1: Factorial matrix for stage 2

2x2x2

Treatment	**School location**		**Pupils' self-efficacy**
	Rural	Urban	High
			Low
Group Interactive Strategy group			
Conventional/ control group			

3.2 Variables for stage 2 of the Study

1. Independent variable

Is teaching strategy manipulated at two levels as follows?

- STAD/Group interactive strategy
- Conventional Teaching Strategy

2. Moderating variables

- Pupils' self-efficacy at two levels (High and Low)
- School location at two levels (Rural and Urban)

3. Dependent variable

- Pupils' achievement in Basic Science
- Pupils' attitude to Basic science

3.3 Selection of Participants

The participants for this study included all final year Primary Education Department (PED) students in two purposively selected Colleges of Education in Ogun State. The basic criterion for the selection of the Colleges of Education was the availability of functional Primary Education Department.Therefore,Only pre-service teachers who had participated in the teaching practice exercise (EDU324) held in the first semester for 300 level were considered suitable to participate in the study. Teaching practice(EDU 324) is a compulsory course offered in all Colleges of Education in Nigeria. It is a basic requirement for the award of Nigerian Certificate of Education (NCE).

Intact class of final year (300 level) students were enumerated. The institutions were randomly assigned to Group Interactive Strategy (GIS) group n=100 and Conventional Strategy group n=82. Twelve pre-service teachers (PSTs) were

randomly selected out of those who scored 65.0% and abovein the GIS group while 12 PSTswere randomly selected from their cohort as control group. In all, twenty-four pre-service teachers participated in the second phase. All the 1,562 public primary schools in Ogun State which has already been grouped into four educational zones by the Ministry of Education were used. These schools were assigned to grades A – D based on their size, number of pupils, location and number of teachers. Purposive sampling technique was used to select three Grade-A public primary schools from each of the educational zones. The choice of Grade A public primary schools was based on the premise that they have more than one arm of primary six with suitable class- size and availability of science kits required for the study. Selected schools were randomly assigned to treatment and control group. Two intact classes of at least 30 students/ class/were used in each school. All the twelve selected primary schools had two arms of primary six (Six A and B). Each of the selected school was assignedtwotrained PSTs from the GIS group (product of stage I) and alternately twountrained PSTs from the Conventional/control group at the rate of twelve PSTs/school location (12 urban and 12 rural schools). The assignment of class teachers was done to avoid infiltration/pollution of ideas that may arise due to interaction of students as shown in table 3.2

Table 3.2: Assignment of treatment groups to pre-service teachers based on school location

	Urban	**Rural**
School identification	1 2 3 4 5 6	7 8 9 10 11 12
No. of PSTs in GIS group	2 2 2	2 2 2
No. of PSTs in Conventional group	2 2 2	2 2 2

In all, twelve trained PSTs from GIS group who were product of stage 1 and twelve untrained PSTs from Conventionalgroup were used to teach 210 primary six pupils in the second phase of the study. The pupils age range was 10.00 to 12.00 and 60% of them were from urban schools.

3.4 Justification of Choice of Concepts

The concepts chosen for this study were Air, Force and Human body circulation. The basic criterion for the choice of the concepts is that the topics were as stated in the primary six basic science curriculum for the term. This is to avoid disrupting the normal school system. Each of the topic represents an area of science. Such as:

Air - Chemistry

Force - Physics

Human body circulation – Biology

3.5 Research Instruments

The instruments comprised of the following:

1. Pre-service teachers' instructional guide for STAD/ Group interactive strategy. (PTISC)
2. Pre-service teachers' instructional guide for lecture method/control *PTILC*
3. Training schedule for pre-service teachers.(PST)
4. CoRe tools for capturing PCK *CoRe- PCK*.
5. PCK scale for PST
6. Pre-service teachers self-efficacy scale PSTSES
7. Pupil's self-efficacy scale PSES
8. Pre-service teachers' classroom observation scale. *PTCOS*
9. Basic science achievement test. *BSAT*
10. Attitude to science questionnaire (ASQ)
11. Marking guide for objective tests

3.5.1 Pre-service Teachers Instructional Guide for STAD/GIS

The instructional guide on STAD Group Interactive strategy (GIS) covered topics such as (Force, Air and Blood Circulation). The STAD cooperative instructional guide includes the following phases.

- Introduction: The teacher introduces the lesson
- Transition to team: Teacher explains how teams will function
- Team study: Each group studies together and teacher monitors groups and supports group effort
- Assessment : Individual students are assessed

- Recognition of achievement: Teacher gives award and commendation in groups by averaging the improvement point for the team. The scale for improvement point is:

  0-5 = 10

  6-10 = 20

  >10 = 30

The process of determining the improvement point is as follows

Group I – StudentsAverage of past record Quiz scoresImprovement point Average

A	95	96	10	
B	88	90	10	
C	75	84	20	70/4 = 17.5
D	69	80	30	

Average group performance is 17.5

Source: Kauchak (2005)

The face and content validity of instructional guide for STAD was determined by giving the instrument to experts in science education for correction, comment, criticisms and suggestions. The instrument was then administered to a group of pre-service teachers who were not be part of the targeted population. Three research assistants were employed to observed and rate the pre-service teachers as they carried out this strategy to determine the reliability of the instrument. The inter-rater index of 0.73 was determined by using scott's formular.

3.5.2 Pre-service Teachers instructional Guide for Conventional/Lecture Method (TGMLM)

The manual in form of lesson note was prepared by the researcher with input from research assistants and co-operating teachers. It involves the following steps: introduction, presentation, student activities and evaluation. The lesson note for conventional/lecture method will be supplied to all pre-service teachers participating in the control group. The face and content validity was done by the supervisor who perused through the draft and made corrections.

3.5.3 Training Schedule for Pre-service Teachers (PSTs)

The training Schedule for PSTs was designed by the researcher to train them on the essential components of PCK. These includes; Orientation towards teaching science, knowledge of students' understanding science, knowledge of science curriculum, knowledge of assessment in science and knowledge of subject specific/topic specific teaching strategy. Some activities in the training package include peer and pair interactions, tutoring on classroom observations scales, demonstration, micro-teaching, video recording of teaching activities and a critique of selected recorded video tapes. The face and content validity of the training package was determined by giving the instrument to scholars in science education for correction, comment, criticisms and suggestions. The instrument was then administered to a group of participants who were not part of the targeted population. Three research assistants were employed to observe and rate the pre-service teachers as they make use of the training package to determine the reliability of the instrument. The inter-rater index of 0.75 was determined by using scott's π formular.

3.5.4 Content Representation tool (CoRe)

The CoRe tool was adapted from John Lougham (2000). The CoRe was developed by selecting and interacting with some qualified senior science lecturers in a mini workshop. Each group was made up of three to four participants. Each group considered the basic concepts a teacher requires to enhance students' understanding using Lougham's proposition as a template.

Lougham (2000) identified 7 ideas on which the formulation of CoRe are based. These are:

- What you intend the students to learn about the idea?
- Why is it important for students to know the idea?
- What else do you know about the idea that you do not intend students to know?
- What are the difficulties connected with teaching this idea?
- What is your knowledge about students thinking?
- What are other factors that influence your teaching the idea?
- Which teaching procedure will you use and reasons for using it?

For every point the PST makes that is identical to the CoRe this will attract a tick. Thereafter, the ticks are added and rated as follows 0-2 low PCK, 3-4 Medium PCK, 5-7 High PCK as indicated below:

Low PCK			Medium PCK			High PCK	
0	1	2	3	4	5	6	7

The face and content validity of the instrument was determined by giving copies of the instrument to experts in science education for their input and corrections. A test-retest reliability was carried out using Pearson Product Moment Correlation which gave a value of 0.03 during the two-week period and this was meant to ensure the stability of the scores over that period of time.

3.5.5 Pre service teachers'PCK scale PSTPCKS

This instrument was adapted from the original instrument which was developed by a team of science educators (Aksu, Mustapha & Aper 2014). It consists of a 15-item questionnaire on a four point Likert Rating Scale such as strongly disagree, disagree, agree and strongly agree aimed at measuring the PCK level of PSTs. The PCK scale has been designed to measure the following pedagogical subcomponents: teaching knowledge (pedagogy) (5 items), knowledge of subject matter (4 items), and knowledge of learners (6 items). The face and content validity was determined by giving copies to experts in science education for comments, observations and suggestions. The final draft of the instrument was administered on a group of pre-service teachers who were not be part of the study to ensure that the guide measured what is was set to measure and to determine the extent to which the items in the test are similar to one another in contents. The reliability coefficient of 0.82 was determined using Cronbach alpha formula.

3.5.6 Pre-service teachers self-efficacy scale PSTSES

This was adopted from the one originally designed by Bandura (2006) to measure how efficient pre-service teachers are in classroom activities and pedagogy. It consists of a 15-item Questionnaire to measure Six dimensions of activities in school. In each of the item there are four options of nothing, very little, quite a bit and

a great deal. The six dimensions attract the following number of items from the questionnaire. These are: Efficacy to influence decision (3 items), efficacy to influence school resources (3 items), efficacy to enlist parental involving (3 items), efficacy to create positive school climate (2 items), instructional self-efficacy (2 items), and disciplinary self-efficacy (2 items). The face and content validity was determined by giving copies to experts in science education for comments, observations and suggestions. The final draft of the instrument was administered on a group of pre-service teachers who were not be part of the study to ensure that the guide measured what is was set to measure and internal consistency. The reliability coefficient of 0.81 was determined using Cronbach alpha formula.

3.5.7 Pupil's self-efficacy scale PSES

The measurement scale for students' self-efficacy consists of a 20-item questionnaire on a four point Likert rating scale such as Strongly Agree (SA), Agree (A), Strongly Disagree (SD) and Disagree (D). The self-efficacy scale has been self-designed by to measure the efficacy of students in some self-efficacy beliefs proposed by Bandura (2006). A list of the beliefs and the number of items in the questionnaire is as follows: remembering (4 items), organizing (4 items), explanations (2 items), understanding (2 items), explaining (2 items), connecting (4 items) and updating (4 items).

The face and content reliability was determined by giving copies of the questionnaire to experts in science education for comments, observation and suggestions. The final draft of the instrument was administered on a group of students who were not part of the study to ensure that the guide measures what it sets to measure. The reliability coefficient of 0.83 was determined using Cronbach alpha formula.

3.5.8 Pre-service Teachers Classroom Observation Scale. *PTCOS*

This instrument was self-designed by the researcher based on the generalized observation tool proposed by Megan, Bridget and Stulhan (2012). It contains a list of classroom activitiesincorporating the essential components of PCK. These are Orientation towards teaching science, knowledge of students' understanding science, knowledge of science curriculum, knowledge of assessment in science and knowledge

of subject specific/topic specific teaching. Appropriate scores are attached to each activity on the assessment sheet.

It has a 5 – point scale of (0 – 5) that observers use to rate teachers during presentation. The observer takes detailed notes about the teacher along the five dimensions when teaching, if he sees a teacher engaging the behaviour under considerations several times. He scores the teacher full marks, credit or a five ("5") on the scale. The observation scale contains sections where observers give remarks on the general observation of teachers and teachers can also give remarks on how they were rated. This is also referred to as their log book.

The face and content validity of pre-service teachers classroom observation scale was determined by giving the instrument to research experts in science education for correction, comments and input. The final draft of the instrument was administered on 50 pre-service teachers who were not be part of the targeted population to ensure that the guide measures what it was set to measure. Three research assistants were employed as raters to observe and rate the pre-service teachers while teaching. The index value of 0.76 was obtained using scott's π formula.

3.5.9 Basic Science Achievement Tests *BSAT*

This is a twenty -item multiple choice test developed by the researcher using a table of specification that consist of the first three cognitive domains in blooms taxonomy namely: knowledge, comprehension and application (Bloom, 1956). Section A of the instrument sought to find information on the participants name, school and gender. While Section B consists of 20 multiple choice test items designed on the following concepts: Force, human body circulation and Air in line with the basic science curriculum. All the multiple choice questions had alternative A to E. Students are expected to tick the correct option from the alternatives provided. The correct option attracted a score of 1 while incorrect option attracted a score of 0. The maximum marks obtainable for the test is 20. The face and content validity of BSAT was determined by giving copies to experts in science education for comments, observation and suggestions. The final draft of the instrument was then administered on 50 primary six pupils who were not part of the study to ensure that the test measures what was meant to measure. Kuder- Richardson 20 (KR20) formula was used to determine the reliability coefficient of the Basic Science Achievement Test. The item difficulty indices were between 0.45 and 0.60. The 20 items were selected

from the pool of 50 items pilot tested. The reliability coefficient of 0.76 was obtained. The table of specification shows the final selected items for the multiple – choice test.

Table 3.3: Table of Specification of Test items for Basic Science Test

Topic	Knowledge	Comprehension	Application	Total
Air	10,11	19	12,13,20	6
Force	1,15	2,4	3,5,14,16	8
Human body circulation	6,7,8,18	17	9	6
Total	**8**	**4**	**8**	**20**

3.5.10 Attitude to science questionnaire (ASQ)

The attitude to science questionnaire was adapted from an on-line opinion panel (2000). The questionnaire is typically structured for 14-16 year olds and it covers areas like the general attitudes and perception of students to science and scientists. The questionnaire is a likert -type where the respondents select from the 4 options strongly agree (SA), Agree (A), Strongly disagree (SD) and Disagree (D).

The face and content validity was determined by giving copies to experts in science education for comments, observations and suggestions. The final draft of the instrument was b administered on a group of pre-service teachers who were not part of the study to ensure that the guide measured what is was set to measure the reliability coefficient of 0.75 was determined using cronbach alpha formula.

3.5.11 Structured Interview Schedule *SIS*

The interview was conducted after the training of participants. The interview was designed to stimulate them to talk about their performance on their PCK development. Information from each interview provided additional details on students' PCK. The interview has a written protocol or guide that indicates what questions are asked and in what order. The interview guide was pilot tested with a group of pre-service teachers that are not part of the study and corrections were effected along with the feedback got the pilot group.

3.6 Research Procedure

The research procedure used in this study is outlined as follows: **Stage 1**

Week	Activities
1	Visit to Colleges of Education to seek permission, selection of individual pre-service teachers and mini – workshop for CoRe development (CoRe is an instrument for measuring PCK).
2	Training of research assistants and co-operating teachers.
3	Administration of structured questionnaires to pre-service teachers on their PCK , teachers' self- efficacy
4-6	Documenting Pre- PCK scores and first selection of PSTs based on their pre-PCK scores , self-efficacy and teaching experience.
7-9	Training programme for the first group of selected PSTs on PCK and assignment to treatment groups. Training on the use of Group interactive strategies.
10-11	Documenting post PCK of pre-service teachers after training..
12	Final selection of participants for stage II of the study based on their PCK level, self -efficacy and teaching experience.
13	Application of pre-test for primary six students on basic science concepts using Basic science Achievement Test
14-17	Application of treatment to the experimental group in Stage II.
18	Administration of post-test using Basic science Achievement Test.
19	Collation of scores and data generated in the study
20	Review of experimental procedure and appraisal for proper storage and documentation.

3.6.1 Research Procedure

Stage 1:

- Development of Content Representation (CoRe) by a group of experienced science teachers in a mini-workshop
- Purposive sampling was used to select two public Colleges of Education in the area of study. The major criterion for their selection was the availability of Primary Education Department in the colleges. The two colleges were

randomly assigned to Group interactive strategy and Conventional strategy groups.

- All the 300 level final year students from the Primary Education department were enumerated.
- They were 100 and 82 students in the two respective colleges. Therefore, the Group interactive strategy group consist of 100 students while the conventional strategy group was 82.
- The pre-service teachers (PSTs) along with research assistants and cooperating teachers were given a brief orientation on what is expected of them.
- Then, the PCKof PSTs in the treatment Group were documented before the training by using appropriate instruments. The Content Representation (CoRe) tools and PCK measurement scale were used along with the PSTs' observation scale (used for evaluating micro teaching) to document the PCK of pre service teachers in the treatment Group.
- The self-efficacy measurement scale was used to document theirself-efficacy.
- The first selection of PSTs was done based on the calculation of all accumulated pre-training scores.
- Participants having 65.0% and above from the Group interactive strategy group were listed n=45.
- From this list, 12 pre-service teachers were randomly selected to participate in finaltraining programme to develop their PCK using the Group interactive strategy (GIS).
- Training PSTs on PSK.
- Then the documentation and final selection of trained Pre-service teachers based on their post PCK and post self-efficacy scores.
- After the training,therandom selection of 12 pre-service teachers in the GIS group.
- Finally, random selection of 12 PSTs from the untrained conventional strategy group concluded stage 1 activities.

Stage 2: Activities commenced with the assignment of selected pre-service teachers (trained and untrained) into their respective schools. This was followed by the administration of pretest for the intact classes of 210 primary six pupils. Then the intervention of the treatment where the selected trainedand untrained pre-service teachers taught primary school pupils the three topics – Air, Force and Human body

circulation using GroupInteractive strategyand Conventional strategy group for 4 weeks. Selected pre-service teachers n=24 implemented the treatment and control as follows;

Experimental/ Treatment Group– Group interactive strategy

Control Group - Conventional / lecture

. This was followed by the administration of post-test for the pupils.

3.7 Method of Data Analysis

The PCK and teachers' self-efficacy were analysed using content analysis, mean, percentages and charts. The null hypotheses postulated in the second stage were analysed using (ANCOVA) Analysis of Covariance and Marginal Means. All hypotheses were tested at $P < 0.05$ level of significance. Graphical Analysis was used to show patterns of performance and interaction.

Analysis of data for each of the Research Questions and hypotheses are as follows:

S/N	Research questions/hypotheses	Nature of Data	Analytical tool
1	Research questions 1 and 2	Quantitative	Percentages, mean and Chart.
		Qualitative	Thematic and content analysis
2	Hypotheses 1-7	Quantitative	ANCOVA and Marginal Means

Qualitative analysis – As Creswell (2005) suggests, analysis of qualitative data started by initial repeated readings of classroom observations, recorded interviews, field notes, cooperating teachers' memo, research assistant jottings, pre-service teachers' log books, transcribed video and audio of teaching activities and pre-service teachers' reflection diaries. Using inductive approach, (Bogdan and Biklen, 1998), certain records, remarks, comments and opinions that occurred repeatedly with commonly emerging patterns were coded and categorized for their thematic overview.

CHAPTER FOUR

RESULTS

This chapter presents the findings of this study. Results are presentedaccording to the research questions and Hypotheses.

4.1 Presentation of Results

Research Questions

Research Question One: Is there any difference in the PCK of pre-service teachers before and after exposure to training in group interactive strategy?

The data obtained to answer this research question is displayed in Table 4.1 and Figure 4.1. Table 4.1 and Figure 4.1 show the PCK of pre-service teachers before and after training.

Table 4.1: The PCK of Pre-service teachers before and after training

PERFORMANCE SCORES													TOTAL	MEAN
PRE-SERVICE TEACHERS	1	2	3	4	5	6	7	8	9	10	11	12		
PRE PCK	151	152	153	151	152	151	151	150	151	150	151	150	1813	151.08
POST PCK	156	154	155	156	157	156	156	156	155	154	156	158	1868	155.67

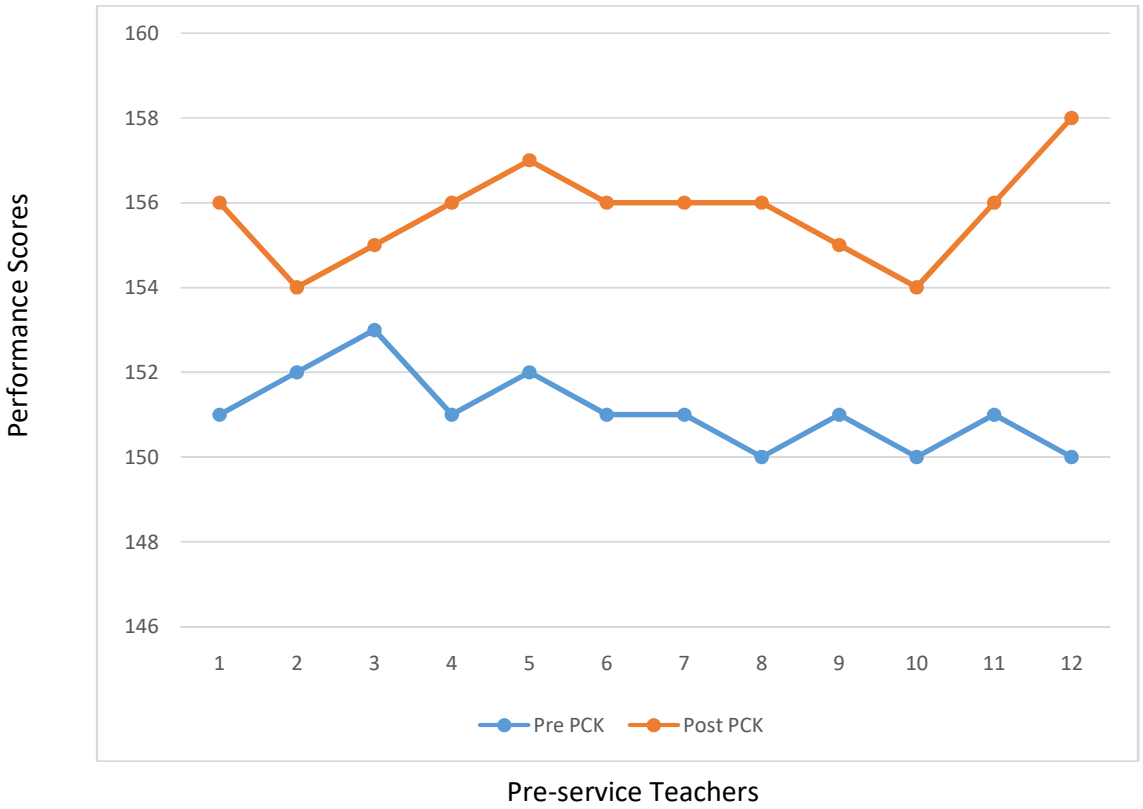

Fig.4.1: The PCK of pre service teachers before and after training

Asshownin Table 4.1 and Figure 4.1 the mean pretest PCK performance scores of pre service teachers(PSTs) was 151.08 while their mean posttest PCK performance scoreofPSTs was 155.67. The total pretest PCK scores for all the twelve PSTs who participated in the training was 1813 while the total posttest scores for all the twelve PSTs who were trained was 1868. The PCK performance scores of each PST before and after training is shown in Table 4.1.

Through the process of qualitative analysis, three themes of PCK development of PSTs emerged. These are; knowledge of content, knowledge of students and knowledge of pedagogy. Table 4.2 presents the improvement indices before and after training according to their knowledge of content, knowledge of students and knowledge of pedagogy.

Table 4.2: Pre-service teachers' Improvement Indices according to their Knowledge of Content, Knowledge Pedagogy and Knowledge of Student

Area of Measurement	Pre-training			Post-training		
	Good No (%)	**Moderate No(%)**	**Bad No(%)**	**Good No (%)**	**Moderate No(%)**	**Bad No(%)**
Knowledge of content	5(42%)	6(50%)	1(8%)	10(85%)	2(15%)	-
Knowledge of students	4(34%)	6(50%)	2(16%)	9(75%)	3(25%)	-
Knowledge of Pedagogy	6(50%)	2(34%)	2(16%)	12(100%)	-	-

As shown in Table 4.2, before the training 42% of pre-service teachers (PSTs) had good knowledge of contents, 50% had moderate and 8% had bad knowledge of contents, while 85% and 15% PSTs had good and moderate knowledge of content respectively after the training. Also, before the training, 34% of PSTs had good knowledge of students, 50% and 16% PSTs had moderate and bad knowledge of students respectively, while 75% and 25% PSTs had good and moderate knowledge of students respectively. As presented in table 4.2, before the training 50% of PSTs had good knowledge of pedagogy, 34% and 16% had moderate and bad knowledge of pedagogy in respective order, while 100% of the PSTs had good knowledge of pedagogy after training with group interactive strategy.

Figure 4.2 presents the improvement indices according to the three themes of PCK. These are knowledge of content, knowledge of students and knowledge of pedagogy.

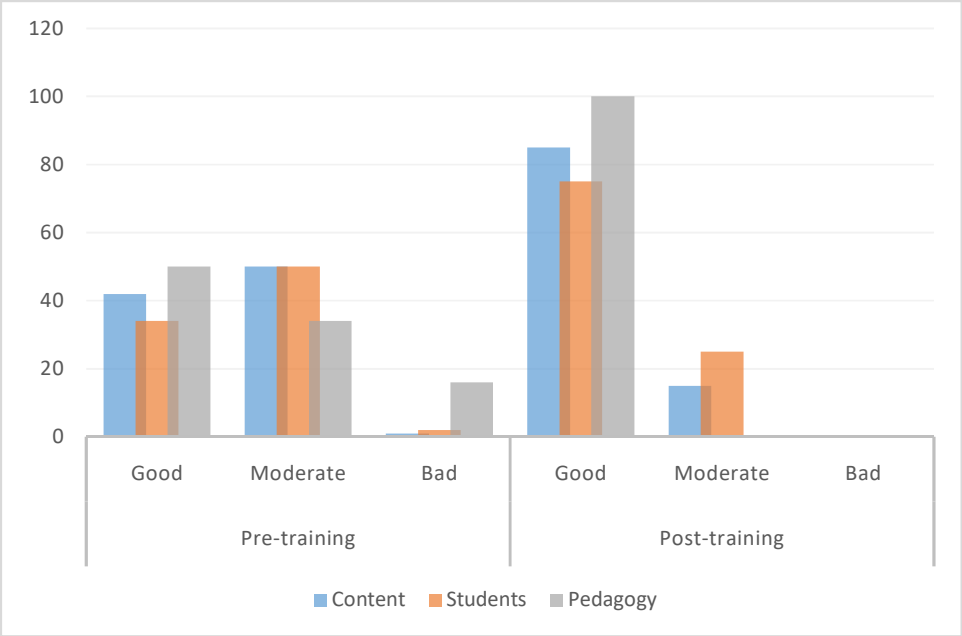

Fig. 4.2: **Pre-service teachers' Improvement Indices according to their Knowledge of Content, Knowledge Pedagogy and Knowledge of Student**

Figure 4.2shows the improvement indices before and after training / development in the knowledge of Content. The figure reveals that the improvement of indices of pre-service teachers (PSTs) which was 42% before training has risen to 85% after training, while 50% of PSTs with moderate performance has reduced to 15%. In the same vein, 8% of PSTs that had bad performance indices has been upgraded to moderate and Good performance. This implies that the PCK of over 85% of PSTs were developed after the training.

In addition, Figure 4.2 indicates that the knowledge of students acquired by 34% Pre-service teachers (PSTs)which was considered as good before the training has increased to75%, while 50% of participants with moderate level of improvement indices before the training has reduced to 25% after training. As shown in the bar chart, 16% of PSTswith bad level of performance on knowledge of students have been upgraded to moderate and good status after the training. This implies that the PCK of PSTshas been developed in the area of knowledge of students after the training with Group interactive strategy.

Figure 4.2 also presents the improvement indices of Pre-service teachers (PSTs) in knowledge of Pedagogy. From the chart it could be observed that variation exists among the improvement indices. As shown in Figure 4.2, PSTswith50%,34% and 16% improvement indices for Good, Moderate and Bad respectively before the training have been developed to 100% improvement indices in their knowledge of students after the training.

Research Question Two: Is there any difference in how pre-serviceteachers rate their self-efficacy before and after training with group interactive strategy?

Table 4.3: The self-efficacy of pre service teachers before and after training

PERFORMANCE SCORES													TOTAL	MEAN
PRE-SERVICE TEACHERS	1	2	3	4	5	6	7	8	9	10	11	12		
PRE SELF-EFFICACY	64	64	62	62	62	64	63	62	63	63	64	63	756	63.4
POST SELF-EFFICACY	72	73	72	73	74	75	73	72	74	75	72	75	880	73.3

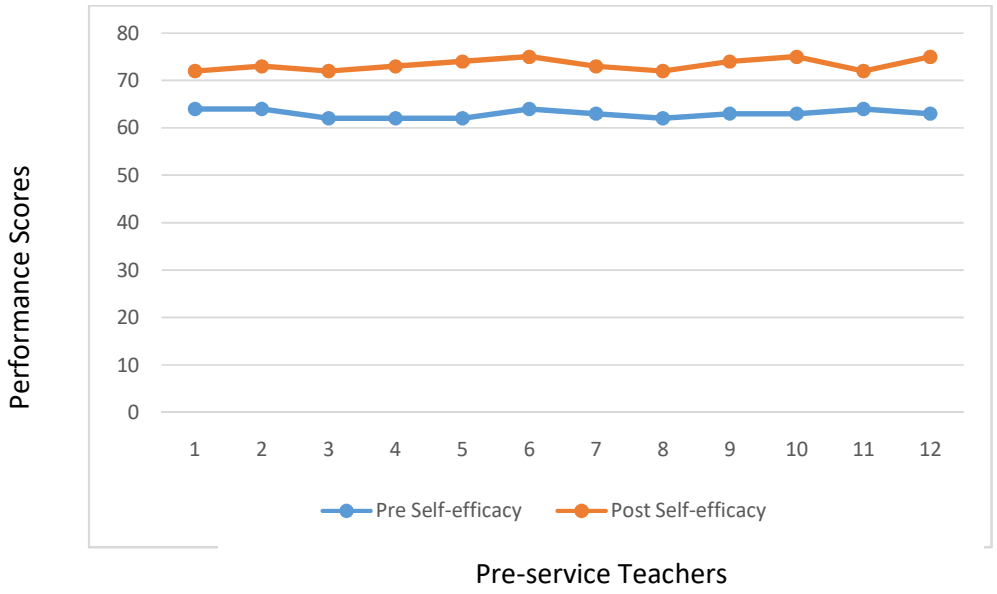

Fig. 4.3: The self-efficacy of pre service teachers before and after training

As shown in Table 4.3 and Figure 4.3 the average self-efficacy of pre service teachers was 63.4 before the training and 65.4 after the training. Also, the Self-efficacy performance scores of each pre-service teacher before and after training showed tremendous improvement in the post training as presented in Table 4.3.

Testing of Hypotheses

H_{O1}(a):There is no significant main effect oftreatment on pupils achievement in Basic Science in Primary Schools.

Table 4.4: Summary of ANCOVA of Post Test Achievement Scores in Basic Science by Treatment, School location and self-efficacy

Dependent Variable: post achievement

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	27753.204[a]	8	3469.151	1052.026	.000	.977
Intercept	3024.721	1	3024.721	917.252	.000	.820
Pre achievement	15857.479	1	15857.479	4808.809	.000	.960
Treatment	332.656	1	332.656	100.879	.000	.333
School location	288.097	1	288.097	87.366	.000	.302
Self –efficacy	2.399	1	2.390	.727	.395	.004
treatment * school location	154.524	1	154.524	46.860	.000	.188
treatment * self-efficacy	1.246	1	1.246	.378	.539	.002
School location * self-efficacy	3.753	1	3.753	1.138	.287	.006
treatment * school location * self efficacy	.043	1	.043	.013	.909	.000
Error	666.113	202	3.298			
Total	140591.000	211				
Corrected Total	28419.318	210				

a. R Squared = .977 (Adjusted R Squared = .976)

*Significant at p<.05

Table 4.4 shows that there is a significant main effect of treatment on pupils achievement in Basic Science ($F/_{1, 202)} = 100.879$, $P<.05$ partial $n^2 = .333$. Therefore the null hypothesis which states that there is no significant main effect of treatment on pupils achievement in Basic Science in primary school is rejected. This implies that the treatment has a significant mean effect on pupils' achievement in Basic science with an effect size of 33.3%.

Table 4.4 shows that the basic science posttest achievement mean score of pupils exposed to Student Team Achievement Division (STAD) is significantly better than those exposed to control / conventional instructional strategies respectively. In order to identify the cause of the significant difference reported in table 4.4 and determine how groups performed the estimated marginal means were computed and these are presented in table 4.5.

Table 4.5: Estimated Marginal Mean of Post Test Achievement Scores in Basic Science

Dependent Variable: post achievement

Treatment	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
GIS	23.902[a]	.54	23.599	24.205
Control	21.156[a]	.226	20.712	21.601

a. Covariates appearing in the model are evaluated at the following values: pre achievement = 19.2000.

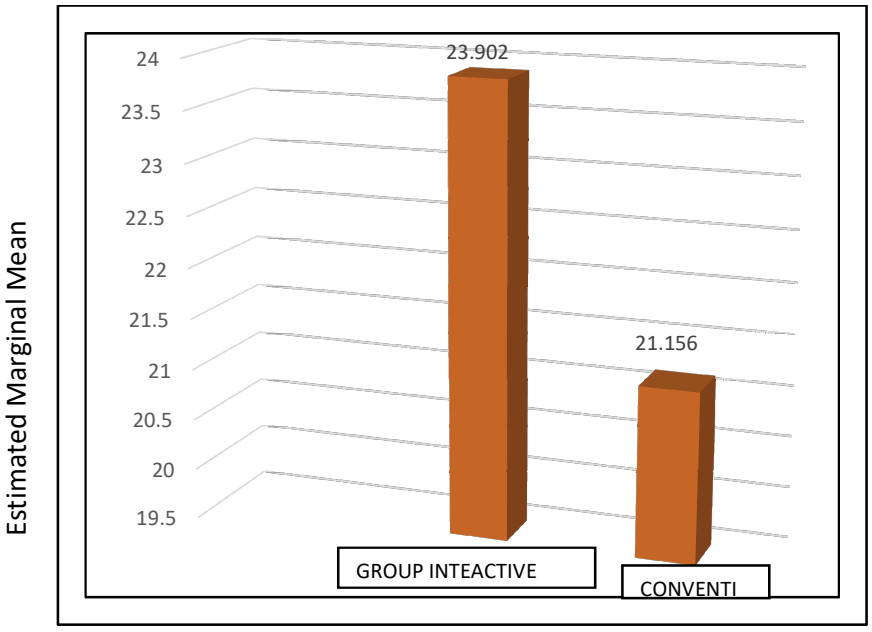

Fig. 4.4: The Estimated Marginal Mean of Posttest Achievement Scores in Basic Science

Table 4.5 reveals that the mean scores of pupils exposed to GIS is the higher (23.902) than the control / conventional (21.156) this implies that the students exposed to Group interactive strategy performed better than those exposed to control/conventional strategy.

Figure 4.4shows the Estimated Marginal Mean of Posttest achievement scores of pupils in Basic science. One can deduce that pupils in the treatment (GIS) group had a mean of 23.90, while pupils in the conventional group had a mean of 21.56. This implies that pupils in the treatment (GIS) group performed better than their counterpart in the conventional group.

Ho_1 (b): There is no significant mean effect of treatment on pupils' attitude to basic science in primary schools.

Table 4.6: Summary of ANCOVA Post attitude scores towards Basic Science by Treatment, School location and self-efficacy

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	28835.251[a]	8	3604.406	622.032	.000	.961
Intercept	1510.153	1	1510.153	260.615	.000	.563
Pre attitude	17966.673	1	17956.673	3100.606	.000	.939
Treatment	5.968	1	5.968	11.030	.011	.050
School location	94.657	1	94.657	16.335	.000	.075
Self efficacy	.173	1	.173	.030	.863	.000
treatment * school location	118.858	1	118.858	20.512	.000	.092
treatment * self efficacy	12.472	1	12.472	.485	.487	.002
school type * self efficacy	1.717	1	1.717	2.512	.144	.011
treatment * school type * self efficacy	1.007	1	5.795	.296	.587	.001
Error	1170.503	202	5.154			
Total	101685.000	211				
Corrected Total	30005.754	210				

a. R Squared = .961 (Adjusted R Squared = .959)

Table 4.6 shows that there is a significant main effect of treatment on pupils attitude towards Basic science ($F_{(1,202)} = 11.030$; $P<0.05$; $n^2 = 0.939$). Therefore, the null hypothesis Ho1b which states that there is no significant main effect of treatment on pupils' attitude towards Basic Science is rejected. This implication is that the treatment has a significant main effect on pupils' attitude towards Basic Science with an effect of 93.9%

To further determine how each of the groups performed, the estimated marginal means were computed and presented in Table 4.7.

Table 4.7: Estimated marginal mean of posttest attitude scores of pupils towards Basic Science in Primary School

Estimated marginal mean

Dependent variables

Dependent Variable: post attitude

Treatment	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
GIS	18.193[a]	.200	17.800	18.587
Control	17.278[a]	.189	16.907	17.650

a. Covariates appearing in the model are evaluated at the following values: pre-attitude = 14.6881.

As shown in Table 4.7, the mean post attitude scores of pupils exposed to GIS is higher than (18.193) Control/conventional (17.278)

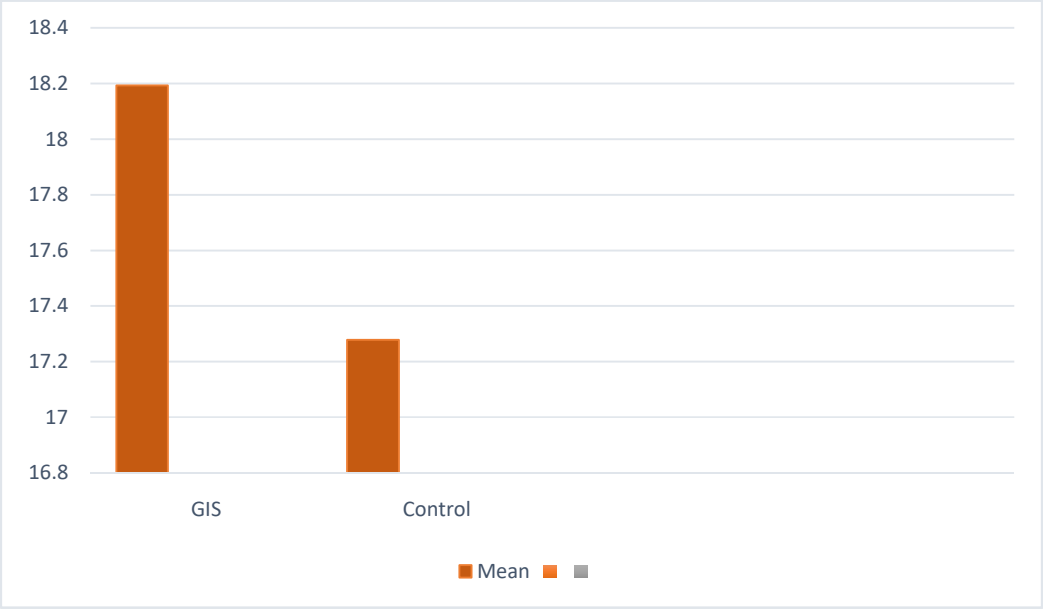

Fig. 4.5: The Estimated Marginal Mean of Post Attitude Scores in Basic Science

Figure 4.5 shows that students from the treatment (GIS) group demonstrated more positive attitude (18.193) towards Basic science than their counterpart in the conventional group (17.278). This implies that pupils in the treatment (GIS) group had a higher post attitude scores than pupils in the conventional group.

$Ho_{2\ a:}$ There is no significant main effect of teachers' self- efficacy on pupils'

(i) Achievement in basic science in primary schools

Table 4.4 indicates that there is no significant main effect of self efficacy on pupils' achievement in basic science $F\ (_{1,202)} =.727;p>0.05$. Therefore the null Ho2a is not rejected. This implies that pupils' self-efficacy has no significant main effect on their achievement in basic science. This can be further explained that having either low or high self- efficacy is neither an advantage or disadvantage to pupils' achievement in basic science.

$Ho_{2b:}$ There is no significant main effect of self- efficacy on pupils'

(ii) Attitude to basic science in primary schools

Table 4.6 shows that self- efficacy has no significant main effect on pupils' attitude towards basic science $F(_{1,202})=0.030:p>0.05$. Therefore the hypothesis Ho2b is not rejected. This implies that the pupils self -efficacy does not determine the pupils attitude t basic science.

$Ho_{3a:}$ There is a significant main effect of school location on pupils'

(i) Achievement in basic science in primary schools

Table 4.4 indicates that there is asignificant main effect of school location on pupils' achievement in basic science $F(_{1,202})=87.366;p>0.05.n=30.2$ Therefore the null Ho3a is rejected. This implies that the school location of pupils has a significant main effect on the achievement in basic science. This can be further explained that the school location is an advantage to pupils achievement in basic scienceTo further determine how each of the groups performed, the estimated marginal means were computed and presented in Table 4.8.

Table 4.8: Estimated Marginal Mean on School location and Pupils' Achievement

Dependent Variable: post achievement

School location	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Urban	23.986[a]	.202	23.588	24.385
Rural	21.072[a]	.212	20.653	21.490

a. Covariates appearing in the model are evaluated at the following values: pre-attitude = 14.6881.

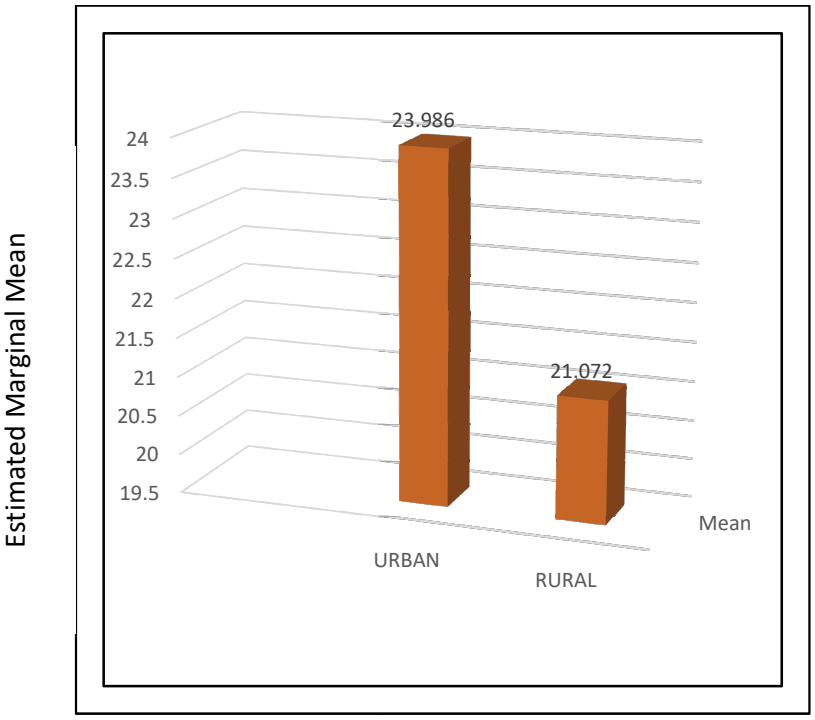

Fig. 4.6: The Estimated Marginal Mean of School Location and Pupils' Achievement in Basic Science

As shown in Table 4.8the mean post attitude scores of pupils exposed to GIS in urban area is the highest (23.986) followed by Control/conventional (21.072)

Figure 4.6 presents the Estimated Marginal Means on school locations and pupil' achievement in Basic science. As indicated in the bar chart, pupils from urban schools demonstrated a more improved performance of 23.98 than pupils from rural schools with a mean of 21.072. This implies that pupils from urban schools are more favoured in achievement than their counterparts in rural schools.

Ho_{3b}: There is no significant main effect of school location on pupils'

(ii) Attitude to basic science in primary schools

Table 4.6 shows that there is a significant main effect of school location on pupils' attitude towards basic science [$F(_{1,202})$=16.335;p>0.05}.Therefore the null hypothesis Ho3b is rejected. This implies that pupils in the rural schools have significant attitude to Basic science when compared with their counterparts in urban schools To further determine how each of the groups performed, the estimated marginal means were computed and presented in Table 4.9.

Table 4.9: Estimated Marginal Mean on School location and Pupils' Attitude

Dependent Variable: post attitude

School location	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
Urban	19.975[a]	.482	19.024	20.926
Rural	16.458[a]	.446	15.578	17.338

a. Covariates appearing in the model are evaluated at the following values: pre-attitude = 14.6881.

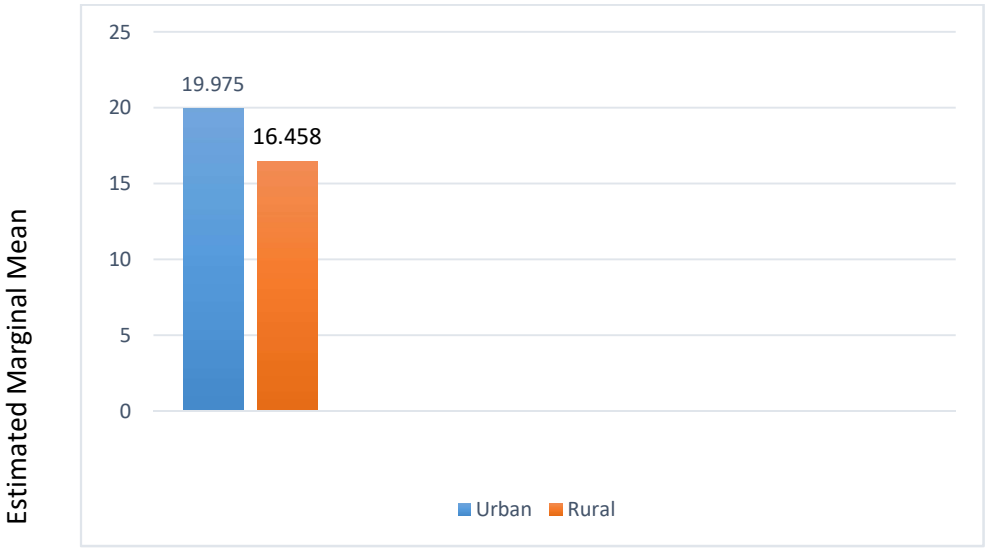

Fig. 4.7: The Estimated Marginal Mean of School Location and Pupils' Attitude towards Basic Science

As shown in Table 4.9the mean post attitude scores of pupils exposed to STAD in urban areas is higher than (19.975) rural areas (16.458)

Figure 4.7shows the Estimated Marginal Mean on school location and pupils' attitude to Basic science. As indicated in the Bar chart, pupils from urban schools had a more positive attitude (19.95) towards Basic science than their counterparts from rural schools with a mean of (16.458)

Ho_{4a}: There is no significant interaction effect of treatment and self-efficacy on pupils'

(i) Achievement in basic science in primary schools

Table 4.4 indicates that the interaction effect of treatment and self-efficacy on pupils' achievement in basic science is not significant $F(_{1,202})$=.378;p>0.05. Therefore the null hypothesis Ho4a is not rejected. This implies that the treatment does not interact with self- efficacy to effect pupils' achievement in Basic science.

Ho_{4b}: There is no significant interaction effect of treatment and self -efficacy on pupils'

(ii) Attitude to basic science in primary schools

Table 4.6 shows that the treatment and self-efficacy has no significant interaction effect on pupils' attitude towards basic science {$F(_{1,202})$=0.485:p>0.05} . Therefore the hypothesis Ho4b is not rejected. This implies that the effect of treatment on pupils' attitude in basic science is not sensitive to pupils' self -efficacy. This implies that the pupils with low self- efficacy benefited in the same way from the treatment like their counterparts.

$Ho_{5a:}$: There is no significant interaction effect of treatment and school location on pupils'

(i) Achievement in basic science in primary schools

Table 4.4 also indicates that the interaction effect of treatment and school location on pupils' achievement in basic science is significant. $F(_{1,202})$=48.660;p>0.05. Therefore the null hypothesis Ho5a is rejected. This implies that the effect of treatment on pupils' achievement in basic science is sensitive to their school location.

$Ho_{5:}$:There is no significant interaction effect of treatment and school location on pupils'

(ii) Attitude to basic science in primary schools

Table 4.6 shows that the treatment and school location has a significant interaction effect on pupils' attitude towards basic science $\{F_{(1,202)=}$ 20 572:p>0.05$\}$. Therefore the hypothesis Ho5b is rejected. This implies that the effect of treatment on pupils' attitude is sensitive to pupils' school location. This implies that the pupils in urban schools benefited more from the treatment than their counterparts in the ruralschools.

$Ho_{6a:}$:There is no significant interaction effect of self- efficacy and school location on pupils'

(i) Achievement in basic science in primary schools

Table 4.4 indicates that the interaction effect of school location and self-efficacy on pupils' achievement in basic science is not significant $F(_{1,202})$=1.138;p>0.05. Therefore, the null hypothesis Ho6a is not rejected. This implies that students' achievement in basic science is not affected by the interaction of their school location and self- efficacy.

$Ho_{6b:}$:There is no significant interaction effect of self- efficacy and school location on pupils'

(ii) Attitude to basic science in primary schools

Table 4.6 shows that the school location and self-efficacy has no significant interaction effect on pupils' attitude towards basic science $\{F(_{1,202})$= 2.152:p>0.05$\}$. Therefore, hypothesis Ho 6b is not rejected. This implies that the effect of school location on pupils' attitude to basic science is not sensitive to pupils' self-efficacy.

$Ho_{7a:}$:There is no significant interaction effect of treatment, self- efficacy and school location on pupils'

(i) Achievement in basic science in primary schools

Table 4.6 indicates that there is no significant interaction effect of treatment, school location and self- efficacy on pupils achievement in basic science $\{F(_{1,202})$=0.013;p>0.05$\}$. Therefore the null hypothesis Ho7a is not rejected. This implies that the effect of treatment on pupils' achievement in basic science is not sensitive to the pupils' school location and their self-efficacy taken together.

Ho_{7b}:There is no significant interaction effect of treatment, self-efficacy and school location on pupils'

(ii) Attitude to basic science in primary schools

Table 4.8 shows that the treatment, school location and self -efficacy has no significant interaction effect on pupils' attitude towards basic science {F $(_{1,202})$=0.296:p>0.05} . Therefore the hypothesis Ho_7b is not rejected. This implies that the effect of treatment on pupils' attitude in basic science is not sensitive to pupils' school location and self-efficacy .Also pupils in rural schools benefited the same way from the treatment like their counterparts in the urban

4.2 Discussion of Results

Results obtained in this study are discussed according to research questions raised and hypotheses postulated earlier in the study.

4.2.1: Research question 1

Is there any difference in the PCK of Pre-service teachers before and after exposure to training with group interactive strategy?

Pre-service teachers recorded significant gains in their PCK after exposure to training with group interactive strategyas scores obtained in micro-teaching assessment and observation scaleas presented in Table 4.1 and figure 4.1 indicate. This could be attributed to the team effort and active involvement of pre- service teachers in the training. This findings is in line with the study conducted by Vandriel (2011) with pre- service teachers and the result showed that reflective efforts such as writing report, and sharing experiences with peers as in group interactive strategy stimulate the development of subject matter knowledge and PCK of pre service teachers.

The initial PCK level of 40% pre-service teachers who participated in the study was low before the training. Many of the PSTs observed before the training were deficient in knowledge of content, knowledge of students and knowledge of pedagogy as indicated in tables 4.2 -4.4. This type of trend has previously being noted by Marks (1990) when he observed that some of the processes of PCK development are rooted in classroom practices, therefore beginning teachers usually have little or no PCK in their repertoire.

In support of this, records from observation scales revealed the following comments made by supervisors about pre-service teachers before the training.

- *Students prior knowledge has no link with concepts to be developed*
- *Contents were explained beyond the level of the students*
- *Gross errors made by students were accepted and group works were difficult to manage*
- *Sometimes lesson steps were not followed*
- *Pre-service teachers ask different questions which students could not answer*
- *Some lesson objectives were not achievable*

However after the training with group interactive strategy, the PCK of the participants had improved. The improvement in their PCK as indicated in (tables 4.3 - 4.6 and figure 4.3) could be attributed to the active participation of the PSTs in the training that included numerous review of video- clips which featured corrected micro teaching presentations and criticism of teaching skills using group interactive strategy as a template. These findings which recorded growth in their PCK after exposure to training,Sperandeo, Fazio and Tarantino (2015) is similar to the previous work of who working with 28 pre- service teachers, in physics found similar results, therefore concluding that the development of PCK is a complex process concerned with the deepening of the subject matter knowledge and improving the awareness of pre service teachers on pedagogical issues. Findings obtained in this study that the training programme enhanced the development of pre-service teachers' PCK reinforces the research work conducted earlier by Julier (2007) when the scholar developed the PCKof pre-service teachers through the use of Lesson study combined with Content representation (CoRe). However, in this study, the training programme imparted significant improvement in the pre-service teachers PCK such that one of the participants wrote this comment in his logbook.

"*I encouraged my students to work together, more than before. I tried to move round the classroom to solve their individual and peer difficulties. I formulated probes, offered hints and provided explanations to difficult concepts in the work-sheets. I understood the students and controlled their excesses. My classroom practices had improved tremendously.* ''

This comment justifies the result obtained in this study as well as the findings from earlier scholars that the improvement in PCK was due to the impact of group interactive strategy adopted in the study. However in a related study Kylic (2009) who

conducted a study on the PCK of PSTs in a method course in Mathematics during field experiences he found out that they had negative experiences due to the low level mathematical knowledge of the participants.

Results obtained from the qualitative / thematic analysis (comparing, coding and triangulation records from classroom observations, field notes, cooperating teachers' memo, pre-service teachers' log book and reflection diaries as well as transcribed video of teaching activities) revealed the emergence of three themes of PCK development. These are; **Knowledge of content, knowledge of students and knowledge of pedagogy.** (Tables 4.2-4.4). Records collated from the knowledge of content of PSTsshow a significant improvement after the training as shown in table 4.2. In a similar study, Dejong (2000) had found out that a special programme focused on transforming the content knowledge of PSTs' to their PCK was successful. Mreover, Kinach (2002) observed that content knowledge of PSTs had a close relationship to their PCK.

Although, majority of the PSTshad high PCK at the end of the training, some of them had challenges transforming their content knowledge into PCK at the beginning of the study judging from logbook reports of some pre-service teachers exemplified as follows:

'I had a lot of challenges in teaching the topic "Force" to the level of Primary six pupils". *In some instances* "*I had to use indigenous language to interpret some concepts of "Air" which was difficult to explain because pupils cannot see it*".

"*After interacting with my cooperating teacher, and reflecting on my teaching activities, with the use of PCK I found it easy to get to the level of the pupils*".

The implication of this result is that the use of PCK rather than Content knowledge and group interactive strategy had made pre-service teachers more efficient in their teaching pedagogy. This finding is similar to the work of Vandriel (2011) who trained pre-service teachers in reflective activities such as writing reports and sharing experiences in collaborative meetings and found that the development of content knowledge and PCK of these pre-service teaches were successful.

One of the factors underpinning the development of PCK of pre-service teachers is their knowledge of students. Students have different characteristics such as age bracket, gender, background, previous knowledge and mental ability. In the context of this study some pre-service teachers had challenges integrating the heterogeneous nature of their students (such as physical and mental abilities, gender,

background and age differences) into their presentation particularly in terms of linking the previous knowledge of students to recent topics such as Air , Force and blood circulation at the beginning of this study.

However, records from micro-teaching assessment grades, classroom observations and review of recorded teaching activities revealed that majority of thePSTs pre-service teachers had low scores in the area of knowledge of students before the training. Some classes were chaotic and not organized, some classroom observation remarks from the researcher and cooperating teachers are as follows:

> "*Most participants have problems linking students' previous ideas to present topic*"
>
> *"Pre-service teachers lack basic classroom organization, preparation and class control"*
>
> *"Distribution of assignment is one-sided, making the weaker students feel isolated on many occasions"*

After the training programme thePSTs acknowledged that they are more informed on the behavior of students; as one of the assessors remarks read:

> *"Pre-service teachers had gained better understanding and they could link pupils' previous knowledge to their recent topic''*

Pedagogy as defined by Lougham (2000) is the science of teaching, instruction and training. As observed in the study, thePSTs' knowledge of pedagogy showed a remarkable improvement as a result of the training. Common remarks of pre-service teachers that emerged after the training showed that teaching was child-centered, class control was greatly improved, curriculum concepts were well interpreted and pre-service teachers demonstrated good orientation in teaching skills, presentation and delivery.Singh and Dwindi (2010), carried out a similar scholarly work to investigate the effect ofPSTs'educational training program on the attitude and achievement of prospective teachers towards teaching using undergraduate teachers. The finding of these scholars indicated a remarkable impact of teacher education training programme on the teaching pedagogy of prospective teachers

Although the teacher education curriculum contains a lot of training programmes such as microteaching methodology, general knowledge, subject knowledge and teaching practice/practicum. Studies from Borko (2004) and Coskam (2013) show that these training programmes are grossly inadequate as most pre-service teachers find it difficult to articulate knowledge bases such as theoretical

knowledge and the pedagogy (methodology) into PCK as earlier suggested in Shulman's PCK model (1986) .

It could be inferred that PCK is simply an intersection of the Content knowledge and Pedagogical knowledge. Findings from this study as reflected in the Post-PCK performance indices in Fig. 4.1shows clearly that PSTs demonstrated implicit efficacy in their PCK after the training programme such that they were able to plan, organize and present their teaching with PCK. One reason that may account for this is the comprehensive nature of the training programme made up of team and peer reviews of recorded micro teaching sessions and regular reflections on instructional delivery.Fig 4.7 and 4.8 present pictures of training sessions with pre-service teachers and the researcher .

Fig. 4.7: The researcher in a training session with PSTs

Fig. 4.8: The researcher in a training session with PSTs

In addition, the PSTs' training programme embarked upon in this research work provided an ample opportunity for them to discuss their strategies, solve their individual and group problems, correct and monitor their progress. In supporting this line of thought, Butler, Novak, Javis and Beckingham (2004) reported that when teachers are trained in teams, they can enrich their own experience develop their understanding and receive new ideas from their colleagues. Thus, allaying the fear earlier raised by Coskam (2013)that the development of PCK of teachers with time and experience is not automatic for all teachers.

Further to this, the participation of pre-service teachers(PSTs) in organized training programmes particularly during teaching practice exercises or practicum is a compulsory course for the award of teachers' certificate. Several efforts made by scholars to develop PSTson PCK during teaching practice have been documented in literature. For instance, Halm (2010) used the assistance of Supervisors during teaching practice training exercise to develop the PCK of PSTs. Equally, Appleton (2008) developed the pedagogical content knowledge of PSTs through mentoring technique. However, a number of scholars have pointed out the ineffectiveness of this programme particularly in the production of quality teachers (Murray & Male, 2005; Udoh, 2000). One of the reasons advanced by these scholars is inadequate time schedule emanating from the need to keep pace with other school activities. However, the use of group interactive strategy for thePCK training in the context of this study is holistic,systematic and does not require a lengthy time frame. This line of argument is justified by the data emanating from the result of the feed-back sessions in this study that the PCK of about 80% of the pre-service teachers was tremendously boosted at expiration of the 4-week training programme.

An interview session with one of the randomly selected participant by pseudo-name Tunde Adebayo succinctly presents the concern some of them experienced before, during and after the PCK development programme conducted in this study.

Researcher – *What do you understand by PCK?*

Tunde Adebayo –*PCK is new to me. I just heard about it in this training*

Researcher – *Do you take methodology courses in your NCE programme?*

Tunde Adebayo – *Yes, but most topics in the curriculum are either skipped or rushed due to time constraint.*

Researcher –. *Did you participate in the teaching practice exercise (EDU 324) which is a compulsory course to be held in 300 level of the NCE curriculum?*

Tunde Adebayo – *I took part in the teaching practice exercise but I was not posted to a primary school to teach Basic Science.*

Researcher – *Was your PCK developed during your teaching practice*?

Tunde Adebayo – *Not quite, for most of us our PCK was not developed because our major concern was to organize our teaching particularly when our supervisor was around to grade us. Aside from this, we concentrated on the use of instructional materials with subject matter knowledge to obtain good grades in the teaching practice exercise and not PCK.*

Researcher – *Can you differentiate between content knowledge and PCK ?*

Tunde Adebayo – *After participating in this training to develop my PCK in this study, I deeply affirm the presence of a wide gap between PCK and theoretical knowledge. Precisely, most of us are always interested in the theoretical knowledge of the subject with little recourse to how, who and why we teach Basic science*.

Researcher – *Reflect deeply on your experiences in the training programme to develop your PCK; kindly explainthe theory and Practice of science teaching.*

Tunde Adebayo – *As an undergraduate in Primary Education Department, before the training I was not good at planning and managing teaching activities, particularly in terms of understanding students' needs and transforming my academic knowledge into teaching situations. But the knowledge I gained in this programme has helped to boost my orientation towards teaching Science and coping with a myriad of activities such as demonstrations, performing experiments and relating with students in and out of classrooms.*

Researcher – *What major challenges about science teaching was corrected after your PCK development training programme.*

Tunde Adebayo – *Some of the challenges I had before the training were difficulty in coping with the diversity of pupils learning styles. Since the Basic science curriculum is spiral in approach there were difficulties teaching topics like force and blood curriculum to the understanding level of the pupils. But after the training, most of these concerns were corrected.*

The extract from the interview sessions presents a vivid picture of the experiences ofPSTs prior, during and after the PCK development training programme embarked upon in this study. The concern expressed by the participants suggests the appropriateness of PCK development and the need to integrate such into the teacher education programme. Besides, some of the findings reported in the interview session are supported by previous research (Watson 2006, Swennen, Joe and Kenthangen, 2004) for instance, Swennen etal (2004), reported thatPSTs experienced challenges in organizing activities, identifying strategies and solving students' misconceptions.To be precise, the expectation is that participants would be able to synergise the knowledge bases initiated by Shulman in order to enhance their instructional delivery.

4.2.2 Research question 2

Is there any difference in how pre-service teachers rate their self-efficacy before and after training with group interactive strategy?

Findings from the study revealed that teachers' self-efficacy improved significantly after their exposure to training using group interactive strategies as stated in Table 4.5 and figure 4.5. Perhaps one reason that can be given for the improvement in PSTs' self- efficacy as observed in the study is the collaborative and inclusive nature of group interactive strategies which might have helped them to be self-reflective and begin to understand the problematic nature of teaching they experienced before training. Therefore increasing their confidence in teaching tasks. According to Pajares (2002) people with weaker levels of self- efficacy take teaching assignments harder than what they truly are which results in sickness, depression and reluctance to teach science and technology. This trend of argument is in line with Mustafa and Glavee-Ges (2019) when they observed that students who have potentials for high self-efficacy put extra effort in tasks assigned to them unlike those with low self-efficacywho are characterised by lack of confidence and mediocrity in task accomplishment.

Several researchers, Bandura(2006); Muhamed, (2011); Mustafa, Esma and Esten, (2012) have also carried out studies on self- efficacy and group interactive strategyand they found that pupils gain more from teachers that exhibit greater enthusiasm for teaching and great commitment to organize small group learning activities , they support pupils autonomy and give special attention to students who are deficient in one way or the other . Their views further consolidate the findings of this study that teachers' self- efficacy is capable of improving when they are trained using group interactive strategy.

The improvement achieved has made many of them more confident teachers when prior to the training they experienced "cold feet" in their teaching assignment in classes, however, the training has definitely removed the fear and timidity. Kylic (2009) asserted that when teachers are trained, both prior to and during teacher education programmesthey combine experience with personal beliefs they gained to shape their decision and self- efficacy. Some findings from previous studies had revealed that many teachers display low self- efficacy after training(Tosun, 2000; Onuka 2015). One possible explanation for this could bedue to the type of training they were exposed to and period of training. However, Palmer (2006) observed higher self- efficacy in primary school teachers particularly when investigated along with their attitude. The improvement in their self- efficacy may also be as a result of the interplay between their PCK and self- efficacy such that as the PCK improves, there is a tendency for it to affect their self- efficacy positively.

To further consolidate the finding that the improvement of pre-service teachers' self -efficacy was as a result of the training and not due to chance, some of the participants, identified by pseudo names Adebiyi Adebola,Bimpe Davies and Sade Muraina were engaged in audio recorded conversation at different occasions with the researcher and the transcribed extract is as follows;

Researcher – *can you give a brief opinion of the training programme?*

Adebiyi Adebola – *quite interesting and educative.*

Bimpe Davies-*Very good.*

Sade Muraina- *It's okay , sir.*

Researcher - *how can you rate your self- efficacy after the training?*

Adebiyi Adebola– *I am now capable ofaccomplishing more teaching tasks. I can deal with students' academic problems more than before*

Bimpe Davies-*It has corrected some difficulties I experienced during my teaching practice.*

Sade Muraina-*Even as at my third year of schooling I have not gained as much*

Researcher – *what aspect of self- efficacy was enhanced by the training?*

Adebiyi Adebola– *I can now take risk and adopt innovations in my teaching.*

Bimpe Davies- *I think my enthusiasm to work.*

Sade Muraina- *My confidence in the classroom has improved.*

Researcher – *how do you see yourself as a teacher?*

Adebiyi Adebola – *I feel good and fully prepared with strong passion for the teaching job.*

Bimpe Davies- *Ican now identify myself as a teacher*

Sade Muraina- *Ithank God for participating in the training.*

An extract from an interview session with some of the participantssuggest that the training programme had significant impact on the self- efficacy of PSTs. This implies that apart from improving the PCK of pre-service teachers earlier observed in this study the training programme influenced their self- efficacy.

Relatedly, a study conducted by Yoo (2016) on web-based development programme of teachersself-efficacy reported a positive effect of the programme. In addition, Yukiko and Shinobu (2016) juxtaposed the school – based training and blended training programme, and they reported that although the teacher education curriculum contains a lot of training programmes such as micro teaching, teaching methods ,subject/General knowledge and practicum/teaching practice exercises ,the latter has the highest impact on self- efficacy. Although, studies from Borko (2004) shows that school-based training programme has the strongest correlation towards self-efficacy among the training activities.

The revelations that the self-efficacy of PSTs improved significantly when exposed to training in group interactive strategy agrees with the findings of other scholars (Palmer, 2006; Tenas, 2013). The implications of this result is that teachers with high efficacy teach effectively in the classroom and students' learning outcomes may be enhanced.

Another implication of these findings is that training programmes such as the one used in this study can effectively improve the confidence, competence and efficacy of pre-service teachers

4.2.3: Discussion of Hypotheses Tested (Main Effect)

Discussion of findings shall be presented according to the hypotheses postulated in the study.

Treatment and Pupils Achievement in Basic Science

Results in Table 4.4 indicate that there is a significant main effect of treatment on pupils' achievement in Basic science in primary schools. This shows that the treatment Group interactive strategy GIS as considered in this study improved pupils' performance achievement in basic science. One possible reason for this result is that when pupils interact freely among themselves, it creates excellent opportunities for them to engage in problem solving tasks along with their group members. This result is in tandem with earlier research works (Okebukola, 1985; Ojo, 1992; Alebiosu, 1998; Yusuf, 2005 and Nwagbo and Okoro,2014) whenthey observedthat group interactive strategy enhanced academic achievement of pupils in sciences.

Although it was shown that the GIS enhanced more improved performance, the result as shown in table 4.4 and fig 4.4favored GIS morethan control/Conventional. This result agrees with the finding of Egbulefu, Amaele and Sunday (2015) group interactive strategy contributes to pupils' achievement scores in basic sciences than conventional because students focus on team goals where the success of one is the success of all. Apart from this, GIS enables pupils to review positive feedback from the process of interactive learning experiences making them imbibe the culture "what we can do together today, I can do alone tomorrow".

Besides, Veenman, Benthem, Bootsna and Kemp (2004), and Hossain (2013) proved in their various studies that students in GIS learning class perform better than those in other non GIS learning class. In a related study Akinsola and Ifamuyiwa (2008) found GIS learning strategy improving students' achievement in mathematics. This may be a reason why Johnson and Stance (2000) see the strategy as widely accepted because of its learner-centered approach one of the best studied pedagogical strategies in the history of education research with over 1,000 research studies. However, this findings may contradict some researchers who found no difference in the performance of students after exposure to GIS and control (Oloyede, Adebowale

and Ojo (2012). However, results obtained in this study along with other previous studies (Agashe 2004, Egbulefu, Amaale and Sunday 2015) have provided sufficient proof to show that Group interactive strategy enhances students'achievement than conventional/ control strategy.

In addition, one may not rule out the possible interplay of the enhanced PCK of pre service teachers which was the basic criterion for their selection to participate in the study. According to Wallance (2005)ee, when training pre-service teachers on their PCK, other aspects of teaching grow over time, he added that PCK construct is capable of improving students achievement.The social Cognitive learning and socio-cultural theories on which this study is premised emphasise that knowledge is developed by expanding the students' zone of proximal development (ZPD).through social interaction and collaboration with parents, teachers and more capable peers. According to Vygostsky as cited by ElIis and Barkhuizen (2005), ZPD is the space between present and potential development). Since GIS is basically hinged on learning by social interaction and collaborative team work, the achievement may be likened to the expansion of students ZPD.

In the context of this study the Vygotsky's ZPD is the interaction stage when the complex assignment which children may not be able to do independently can be accomplished with the help of from more skillful peers and capable adults.

Fig 4.12 presents the diagrammatic illustration of ZPD

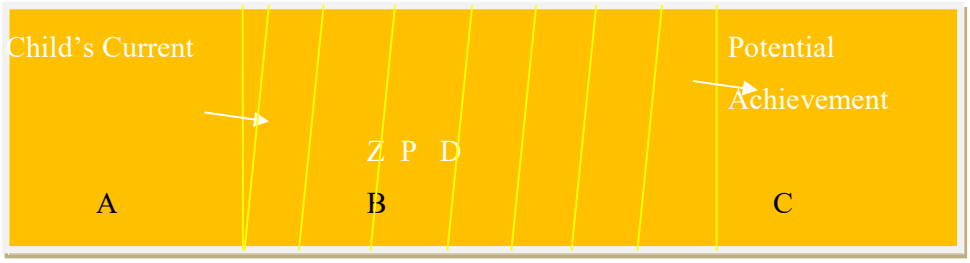

Fig. 4.10. Diagrammatic representation of ZPD

As indicated in the diagram; A is the actual/present cognitive level of students when a child have the independent ability B is theZonal of Proximal development(ZPD) as influenced by more capable peers and adult and C in the potential achievement stage when a child can now perform difficult tasks individually .Obviously, the ZPD and GIS are similar in approach and context. Perhaps this Vygotsky's Socio cultural line

of thought may drive students' performance and account for the statistically significant difference in achievement scores with basic science primary six pupils when taught with GIS as compared with conventional/control group.

Further to this, results obtained and shown in table 4.3 also indicate that students exposed to GIS performed better than conventional groups. One reason that may account for this finding is that, students exposed to GISwork together. They also help each other to achieve group goals unlike in conventional strategy where students work independently making them obtain less scores whenjuxtaposed with Group interactive strategy. In a related study, Slavin (2011) found out that students pupils taught using to Group interactive strategy perform better than conventional groups because students were conscious of the way they perform as well as their colleagues in the same group. Johnson and Johnson (2006) supported this line of arguments when they reported that GIS promotes collaboration, constructive interaction and fulfilled achievement.

4.2.4 Treatment and Pupils Attitude to Basic Science

Results obtained in this study as presented in table 4.6 shows that the effect of treatment on pupils' attitude to basic science in primary schools is significant. This is an indication that Group interactive strategy has contributed to their positive post attitude scores of students in Basic science. Perhaps the social interactive attributes of GIS such as team work, interdependence of students and group goals must have contributed to the positive attitude observed in the result. To corroborate this findings, Osalusi (2009) using an empirical researchinvestigated the impact of Group interactive strategy and the attitude of pupils and the result shows that pupils exposed to GIS has improved in terms of attitude. Also, Okebukola and Oguniyi (1984) who studied the effect of pupils' attitude to science when taught with GIS found similar results in their various studies. The study further reveals that the students exposed to Group interactive strategy had a higher (18.193) mean score than the conventional/control (17.27). This result also confirms the study earlier conducted by Agashe (2004) who observed that the use of group interactive strategy promotes positive attitude towards science more than the conventional strategy. Similar results were obtained by kolawole (2007), UNESCO (2007, Yildran and Aydiri (2005).

In related studies, Hossain (2013), Akinsola and Ifamuyiwa (2008) found Group interactive learning strategy improving students' attitude towards

Mathematics.Although the study conducted by Danjuma (2015) on the effect of group interactive strategy showed that group interactive strategy did not significantly influence pupils' attitude to science. When the result obtained in this study is compared with that of Danjuma (2015), an interesting difference which may be explained in the quality of participants in the two studies may come to play. Unlike the study carried out by Danjuma, pre-service teachers in this study were trained on their PCK and the best of them having high performance indices were selected to participate. Therefore, the PCK training may be responsible for the revelation recorded in this study. Wyk (2013) also examined the contribution of GIS on students' attitude of group interactive strategy on the motivation in Economic modular education and found out that GIS compared to direct instructions promote positive attitude towards the dependent variable.

4.2.5 Effect of Self efficacy on Pupils' Achievement in Basic Science

Findings from the study reveals that there is no significant effect of teachers' self- efficacy on pupils' achievement in Basic Science One reason that may account for this result is that primary school pupils may shy away from difficult task particularly when working in groups. In addition, the mixed ability grouping of group interactive strategy may result in relatively brilliant students with high mental ability, depriving their counterparts from fully expressing themselves, leading to nostalgic feelings, fear of failure and fear of breaking of scientific equipment and glass wares which may lead to poor performance. The result is similar to that of Shahzad, Mohammed Hurthman and Hossein (2011) when they revealed that self-efficacy cannot be presumed as the direct reason for the achievement of students. The result also agrees with a study conducted by Chang and Westwood (2007) when they reported that self- efficacy could not predict students' academic efforts. The result obtained in this study is in contrast with the assertion of, Tschannen, Moren and Hoy (2001) that self-efficacy is significant to pupils' achievement. Perhaps, the contradictory result may be because participants were from secondary schools unlike primary school pupils engaged in this study.

Interaction Effects

4.2.6 Effect of Self efficacy on Pupils' attitude to Basic Science

The result obtained in this study shows that self -efficacy has no significant main effect on pupils' attitude to Basic Science. Perhaps, this may be because pupils attitude tend to take longer time to manifest when working in group. Furthermore, some students may find some problem- solving tasks such as the determination of the weight of air, calculation of force and identification of blood vessels very challenging within and among their groups and this may lead to gradual build up or loss of interest in science. In addition, Lilian (2012) had identified poor grades in previous examination, weak group models and interaction with peers as factors that may be responsible for the inability of self-efficacy to determine pupils' attitude to Basic Science in Primary Schools.

4.2.7(a)

EffectofSchoollocationonpupils'achievementinBasicSciencei nPrimaryschool

Reports obtained show that there is a significant main effect of school location on pupils' achievement in. This may arise as a result of the concentration of modern technology and availability of educational facilities in urban areas unlike what operates in schools located in rural areas. The implication of this result is that pupils' performance in Basic science is influenced by the location of school pupils attend, whether rural or urban. In the context of this study, pupils from urban areas outperformedtheir counterparts from rural schools. Ntibi and Edoho (2007) found similar result when they investigated the influence of school location on pupils learning outcome in Mathematics and science . This is in contrast with the work of Bosede 2010 and Akinwunmi (2017) in which they observed no variance in posttest scores of pupils from different school locations. Similar result was obtained by Gana (2007) whose study revealed equal achievement scores in Science in Urban and Rural schools.. However, the views of Mburu (2013) and Owoeye (2000) consolidate the result obtained in this study.

4.2.7(b)Effect of School location on pupils attitude to Basic science in Primary school

Findings from this study showed that there is a significant main effect of school location on pupils' attitude towards basic science. The implication is that pupils in rural areas do not exhibit a attitude to basic science like their counterparts in urban areas. In the context of this study, students from urban schools had a more positive attitude than their cohorts in rural schools. One may argue that the heterogeneous and the less challenging attribute of rural life in Nigeria may make the pupils avoid schools especially on market days. Another reason could be the social economic status of rural dwellers which may not support quick attitudinal changes of students towards science. Results obtained by various researchers on the same subject matter further corroborate this findings. For instance, Obe (2004) and Howley (2003) found a remarkable difference in the attitude of students from urban and rural schools. In contrast, Axtel and Browers (2002) observed that the urban / rural factor is not a determinant of pupils' attitude to science.

4.2.8 (a) Interaction effect of treatment and self- efficacy on pupils' achievement in Basic Science

Results obtained in this study shows that the interaction effect of treatment and self-efficacy on students' achievements is not significant. This implies that the combined effect of treatment and self-efficacy in basic science is not sensitive to their achievement.. The result is supported by Chang and Westwood (2007) who in their study found out that students with variance in efficacy perform at the same rate after exposure to the treatment.

4.2.8(b)Interaction effect of treatment and self -efficacy in pupils' attitude to Basic Science

Findings show that the interaction effect of treatment and self- efficacy was not significant. This can be interpreted that the attitude of the pupils towards science was not affected by their self-efficacy. However, the result obtained in this study is corroborated by Edem (2015) whose study reported no interaction effect between group interactive strategy and self -efficacy towards the improvement or otherwise of pupils attitude in basic science.

4.2.9(a) Interaction effect of treatment and school location on pupils' achievement in Basic science

Report obtained revealed a significant interaction effect of treatment and school location on achievement of pupils . This means that the effect of the group interactive strategy on pupils' achievement is sensitive to the location of school pupils attend. Hence pupils in rural schools did not benefit the same way from the treatment (GIS) like their counterparts in urban schools .A study earlier conducted by Akinwunmi (2017) lend credence to this finding that pupils from urban schools outshine their rural -based counterparts. A contradictory result was found by Yusuf, Thomas, and Gambari (2015) where students performed better when exposed to STAD treatment irrespective of their school location.

The implication of this result is that treatment and school location mutually interacted to influence pupils achievement in Basic Science. In addition ,there is a variance between the performance of pupils from rural and urban schools after exposure to group interactive strategy. Unlike the control group where urban students performed significantly better than their cohorts in rural areas. Rural based students performed better than students from urban in the control group. Hence, the interaction is disordinal. From the demographic information we can deduce that 60% of the pupils are from the urban areas while 40% of the student are rural based.

The implication is that students performance is more to the urban areas than the rural areas after exposure to t he treatment. One reason that may account for this result is the socio-economic status of parents of urban areas that may have impact on the readiness of the pupils to participate in the classroom during group interactive strategies. In addition, pupils from the rural areas may feel inferior and complacent during classroom interactive sessions and this may affect their performance. These findings are in line with the earlier findings of Craig (2010) and Mburu (2013) who found similar results in mathematics.

4.2.9(b) Interaction effect of treatment and school location on pupils attitude to science

The result obtained in this study shows that the treatment and school location have a significant interaction effect on pupils' attitude towards Basic Science. The implication of this result is that the impact of treatment on pupils'attitude issensitive

to pupils' school location.In the context of this study students from urban areas had more positive attitude after the treatment than students from rural areas. One reason that could account for this is the inadequacy of qualified science teachers in most rural areas unlike what obtains in urban areas. In tandem with this result, Howley (2003) reported a significant interaction effect of school location and Group interactive strategy. However, Oginni, Awobodu, Ala and Saibu (2013) reports that attitude to Basic science is not school location specific.

Findings from this result also indicate a significant interaction effect of school location and the treatment on pupils' attitude. The reason for the significant interaction effect of treatment and school location on the attitude of pupils in Basic Science could be associated to the lack of instructional facilities in rural areas.

4.2.10(a)Interaction effect of school location and self- efficacy of pupils' achievement

Analysis of result reveals that the interaction effect of school location and self-efficacy on pupils' achievement in Basic science is not significant. This implies that the effect of school location on pupils' performance is not sensitive to pupils self - efficacy. This findings lend empirical evidence to the studies of Enock, Smith and Hunker(2015) and Zee (2016) who observed that the interaction between self-efficacy and school location have no significant interaction effect on pupils' performance in Basic Science.

4.2.10 (b): Interaction effect of pupils' self-efficacy and school location on pupils' attitude to basic science

The result obtained in this study revealed that the school location and self-efficacy have no interaction effect on pupils' attitude towards basic science. This can be interpreted that the effect of school location on pupils' attitude in Basic Science is not sensitive to pupils' self- efficacy. This aligns with the result obtained from Fernando, Laura and Amparo (2014) when they discovered that the interaction effect of self- efficacy and school location does not contribute to the satisfaction (attitude) and achievement of students.

4.2.11 (a); Interaction effect of the treatment, school location and self- efficacy on pupils Achievement in Basic science

Results obtained in this study show that the treatment, school location and self- efficacy have no significant interaction effect on pupils' performances in Basic science. This implies that the effect of group interactive strategy on pupils' achievement is not sensitive to pupils' school location and self -efficacy. The result obtained from this research work is corroborated by Javier,Antonio and Prieto (2017) who reported that there was no combined effect of group interactive strategy, school location and self-efficacy on pupils' performances in Basic science.

4.2.11 (b) Interaction effect of treatment, school location and self -efficacy on pupils'Attitude to Basic science

Analysis of result show that the treatment, school location and self- efficacy have no significant interaction effect on pupils' attitude to Basic science .This implies that the effect of Group interactive strategy on pupils' attitude is not sensitive to pupils' school location and self- efficacy. This result contradicts the position of Uitho (2010)who observed significant interaction effect of Group interactive strategy,self-efficacy and school location on undergraduatestudents' attitude to chemistry.

CHAPTER FIVE

SUMMARY OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

This chapter presents the summary of findings, recommendation and conclusion.

5.1 Summary of Findings

Findings of the study are summarized below in order in which they are presented

1. The pedagogical content knowledge (PCK) of pre - service teachers was low before and high after exposure to training with group interactive strategy.
2. The pre- service teachers rate their self -efficacy as low before training and high after exposure to training with group interactive strategy.
3. Pre- service teachers teaching experience is an important factor in their PCK development.

4a. There was a significant main effect of treatment on pupils' achievement to basic science in primary school.

b. There was a significant main effect of treatment on pupils' attitude to Basic science in primary schools.

5a. There was no significant main effect of self- efficacy on pupils' achievement in basic science in primary schools.

b. There was no significant main effect of self- efficacy on pupils' attitude to Basic Science in primary schools.

6a. There was a significant main effect of school location on pupils' achievement in Basic Science in primary schools. Pupils from urban schools performed better than their counterparts in rural schools.

b. There was a significant main effect of school location on pupils' attitude to Basic Science in Primary School. Pupils from urban schools had more positive attitude than pupils from schools located in rural areas.

7a. There was a significant interaction effect of treatment and school location on pupils' achievement in Basic science.

b. There was a significant interaction effect of treatment and school location on pupils' attitude to Basic science.

8a. There was no significant interaction effect of treatment and self- efficacy on pupils' achievement in Basic science.

b. There was no significant interaction effect of treatment and self – efficacy on pupils' attitude to Basic science.

9a. There was no significant interaction effect of school location and self- efficacy on. Pupils' achievement in Basic science

b There was no significant interaction effect of school location and self- efficacy on. Pupils' attitude to Basic science

10a. There was no significant interaction effect of treatment, school location and self- efficacy on pupils' achievement in Basic science.

10b. There was no significant interaction effect of treatment, school location and self -efficacy on pupils' achievement in Basic science.

5.2 Conclusion

The crux of this study was to train pre service teachers to improve their pedagogical content knowledge (PCK) and self- efficacy using group interactive strategy and determine their effect of group interactive learning outcome of pupils in Basic Science. The findings from this study showed that pedagogical content knowledge (PCK) and teachers' self -efficacy are important variables that shape pre service teachers and prepare them for effective teaching of basic science in primary schools. It was also observed that pre-service teachers PCK and self- efficacy improved after they were exposed to training with group interactive strategy. From the foregoing, it could be deduced that by introducing PCK into teacher education programme, it would enhance pre-service teacher classroom practices and the learning outcome of pupils in basic science in primary schools. This study further established that pupils' achievement and attitude to basic science are capable of improving when taught with STAD group interactive strategies irrespective of their self- efficacy. This may be attributed to the fact that STAD group interactive strategy create opportunities for learners to interact with their peers to explore, pose questions, acquire knowledge and work collaboratively towards improving their activities and attitude to science. The investigator thus considers the use of STAD group interactive strategy as the most suitable for boosting the PCKof pre-service teachers and for teaching Basic Science in primary schools.

5.3 Education Implication of Findings

The findings of this study have the following implications.

1. Pupils' performance and attitude to Basic science in primary schools is low and pre-service teachers' pedagogical content knowledge has been identified

as one of the factors that affect the classroom practices of pre service teachers and learning outcome of pupils in Basic Science.

2. The study established that teachers' pedagogical content knowledge (PCK) and self- efficacy are important for the preparation of pre service Basic Science teachers.
3. Pre service teachers PCK and self-efficacy can be developed when they are trained with group interactive strategy.
4. Group interactive strategy is suitable for training pre-service teachers on PCK and forteaching Basic Science in Primary Schools.
5. IfGroup interactive strategy is adopted, the achievement and attitude of pupils to Basic Science would improve irrespective of the location of school they attend.
6. Pupils achievement and attitude to Basic science in primary schools are not affected by their self -efficacy but influenced by their school location.

5.4 Contribution to Knowledge

The study has established that teachers' pedagogical content knowledge is an important factor in teacher education programme because it has been established in this study that PCK is the right type of knowledge pre- service teachers needed for effective teaching of Basic science in primary schools and the PCK of pre-service can be developed through training.

The study also identified self-efficacy and teaching experience as important variables in teacher preparation because they make pre service teachers more confident and capable in Basic science classrooms.

Another major contribution is the revelation that group interactive strategy is a suitable strategy for teaching Basic science in primary schools. The achievement and attitude of primary school pupils to Basic science not affected by their self-efficacy but influenced by their school location.

5.5 Recommendations

1. Basic Science should be taught by specialist teachers (Primary Education Studies Pre-service teachers) in primary schools as specified in the National Policy on Education

2. Teacher training institution and curriculum planners should incorporate pedagogical content knowledge (PCK) training in the teacher education programme. This can be done by exposing pre -service teachers to video tapes showing various aspects of PCK for their analysis, critique and replication with the hope of developing their PCK and addressing students learning outcomes in Basic Science in primary schools.
3. A compulsory one year internship programme for preservice teachers where their PCK self- efficacy and STAD cooperative strategies are developed before transiting to become full time in-service teachers is advocated for Basic Science teachers in primary schools.
4. Heads of institutions, inspectors of schools and quality assurance department should ensure the implementation of Group interactive strategy for teaching Basic science in primary schools. It is hoped that when more people adopt Group interactive strategy the much desired learning outcome of pupils would be achieved.
5. Textbook authors / writers should shift emphasis from teachers' activities to pupils' activities that emphasise teamwork, collaboration, positive interactive among peers as in Group interactive strategy.
6. Employees of teachers should organize seminars, workshops, conferences, long and short term in-service programmes at intervals for primary school Basic science teachers to boost their PCK and inform, upgrade and refresh them on the use of Group interactive strategy.
7. Government should be sensitized to sponsor training programmes and provide avenues for students to interact freely and work cooperatively as in Group interactive strategy to improve their achievement and attitude to science.

5.6 Limitation of the Study

1. The qualitative part of this study was conducted in two Colleges of Education in Ogun State mainly because the remaining Colleges of Education in Ogun State (though private) did not have functional Primary Education Department.
2. Group interactive strategy requires adequate space and infrastructure. Constraints occasioned by large class size, inadequate infrastructure and

overloaded school calendar may bring some limitations for the effectiveness of the study.

5.7 Suggestions for Further Studies

1. The study should be replicated with primary education students in the other parts of Nigeria.
2. The use of Technological pedagogical content knowledge (TPCK) and subject specific pedagogical content knowledge (SPPCK) for similar studies for pre-service and In-service teachers can be used for future research work

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APPENDIX I A

1A. PRE-SERVICE TEACHERS' INSTRUCTIONAL GUIDE FOR STAD GROUP INTERACTIVE STRATEGY 1

TOPIC: **Force**

CLASS: **Primary Six**

OBJECTIVES: **Students should be able to**

- **Define force**
- **List the types of forces**
- **Mention of effect of forces.**

DOMAIN: **Cognitive, Affective and Psychomotor**

Instructional Materials: metals, magnet, ball, comb, pieces of paper, balloon and electric

STRATEGY PRESCRIPTION: GROUP INTERACTIVESTRATEGY

A – Introduction Phase

Step I: Teacher introduces the lesson to the pupils

Step II: Teacher presents the materials and explains the worksheets

B –Transition to teams phase

Step III: Teacher explain how STAD cooperative teaching strategy works and outlines specific procedures as follows:

Teachers introductive statement and procedures on STAD cooperative teaching strategy

Pupils, I am going to divide you into the groups that you will be working with. Each group will have four members and four worksheets. Two members of each of the group will form a pair. Each person does his work and checks with his or her partner. If they agree and understand it, they move to the next problem, if they disagree they ask the other pair and all the four members discuss the problem until they are sure they understand it. But if the four members disagree they can ask me (the teacher)

Step IV: Students are assigned into groups of four pupils per group using their pretest performance, age, sex, cultural and background as a template / criteria.

C – Team Study Phase

Step V: Teacher provides worksheet for team study. The worksheet will be provided for each group as guides which they consult as they share ideas among themselves.

Worksheet for the Concept Force

Activity 1

- Pushing and pulling of objects
- Moving a stationary object
- Changing the direction of a moving object
- Stop a moving body

Concept/ Fact

- To define force

Activity 2

- Throw ball/objects up and allow to drop
- Rub a comb with a piece of cloth and use it to pick pieces of paper
- Identify magnetic and non-magnetic objects
- The magnet to pick non-magnet objects
- Identify and discuss force in electric wires

Concept/ Fact

– To identify types of forces as contact and non-contact force gravitational, magnetic electric force Pupils work in groups and perform activities1 and 2.

Step VII: Teacher monitors the activities and their interpretations

D – Assessment Phase

Step VIII:

- What is force
- Name 2 types of forces
- Name 3 examples of non-contact force

Step IX: Scores are collected using improvement and base scores

E - Recognition of Achievement Phase

Step X: Teacher finds the average of each group and reward with team goals.

APPENDIX I B

PRE-SERVICE TEACHERS' INSTRUCTIONAL GUIDE FOR CONVENTIONAL STRATEGY 1

1b.

TOPIC: **Force**

CLASS: **Primary Six**

OBJECTIVES: **Students should be able to**

- **Define force**
- **List the types of forces**
- **Mention of effect of forces.**

DOMAIN: **Cognitive, Affective and Psychomotor**

Instructional Materials: metals, magnet, ball, comb, pieces of paper, balloon and electric wire.

STRATEGY PRESCRIPTION: CONTROL /CONVENTIONAL PACKAGE

Step I: Teacher introduces the lesson by asking questions to link the previous ideas to new ones e.g what is pushing or pulling.

Step II: Teacher assists students to define force as any action that helps to move an object or change its speed.

Step III: Teacher names the 2 types of forces as contact force and non-contact force.

Step IV: Teacher explains contact force as a force that need to touch each other while non-contact as a force that does not necessarily require touching each other.

Step V: Teacher gives example of contact force as push, pull, and friction. Non-contact force as gravitational, magnetic and electric.

Step VI: Teacher explains gravitational force as any force that make an object thrown up to come down.

- Electric force as a force generated by charged forces.
- Magnetic force from the magnet attracting metallic objects.

Step VII: Teacher evaluates the class with these questions.

- What is a Force?
- Name 2 types of Forces
- Name 2 examples of contact force.

APPENDIX I1 A

PRE-SERVICE TEACHERS' INSTRUCTIONAL GUIDE FOR STAD/ GROUP INTERACTIVE TEACHING STRATEGY 2

TOPIC: **Air**

CLASS: **Primary Six**

OBJECTIVES: **Students should be able to**

- **Define air**
- **List the components of air**
- **State the properties of air.**

DOMAIN: **Cognitive, Affective and Psychomotor**

Instructional Materials: balloon, hand-fan, weighing balance, candle stick, paper scrap.

STRATEGY PRESCRIPTION: : GROUP INTERACTIVE STRATEGY

Phases A – Introduction phase

Phase B – Transition to team phase**A – Introduction Phase**

Step I: Teacher introduces the lesson to the pupils

Step II: Teacher presents the materials and explains the worksheets

B –Transition to teams phase

Step III: Teacher explain how STAD cooperative teaching strategy works and outlines specific procedures as follows:

Teacher's introductory statement and procedures on STAD Group interactive teaching strategy.

Pupils, I am going to divide you into the groups that you will be working with. Each group will have four members and four worksheets. Two members of each of the group will form a pair. Each person does his work and checks with his or her partner. If they agree and understand it, they move to the next problem, if they disagree they ask the other pair and all the four members discuss the problem until they are sure they understand it. But if the four members disagree they can ask me (the teacher)

Phase C – Team study phase

Step V: Teacher provides work sheet for team study

Worksheet on the topic Air

Activity 1

- Blow a hand fan around your face
- Can you see the substance
- Can you feel it
- What make up the substance
- What do you breath in and out
- Is the substance requires for burning

Concept/ Fact

- To define air
- Name the constituents
- State the uses

Activity 2

- Make a light from a candle stick
- Lit a candle stick
- Cover the candle stick with a container
- Observe what happens

Concept/ Fact

To identify the properties of air such as Air supports combustion

Activity 3

Fly a kite with rope

Place a balloon on a scale and weight it

Blow the balloon with air in the mouth

Compare the 2 weights observed and reflect on observed facts

Property – Air has weight and occupies spaces

Step VI: Pupils work in groups, perform their activities, share and reflect on their knowledge

Step VII: Teacher monitors the groups

D – Assessment phase

Students answer the following questions

- What is air
- Name the constituent of air

- State 2 properties of air
- State 2 uses of air

Step VIII: Scores are collated using improvement and Base scores

E – Recognition of Achievement Phase

Step IX: Teacher finds the average of each group and reward with team goals

APPENDIX I1 B

PRE-SERVICE TEACHERS' INSTRUCTIONAL GUIDE FOR CONVENTIONAL STRATEGY 2

2b STRATEGY PRESCRIPTION:CONTROL/CONVENTIONAL STRATEGY

TOPIC: **Air**

CLASS: **Primary Six**

OBJECTIVES: **Students should be able to**

- **Define air**
- **List the components of air**
- **State the properties of air.**

DOMAIN: **Cognitive, Affective and Psychomotor**

Instructional Materials: balloon, hand-fan, weighing balance, candle stick, paper scrap.

STEP I: Teacher introduces the lesson by giving a definition of air.

- Air is a mixture of gases.
- He lists the constituents of Air as O_2, CO_2 N_2, Water vapour and Noble gases.

STEP II: Teacher explains the properties of air as follows:

- Air can be felt
- Air occupies spaces
- Air has weight
- Air can be compressed
- Air supports combustion.

STEP III: teacher asks students on the uses of air.

They state the uses of air as follows:

Air is used for breathing

Air is used for burning

Air is used by aeroplane for flying.

Air supports life.

STEP IV: Teacher gives a summary of the activities

EVALUATION:

- What is air
- Name the constituent of air

- State 2 properties of air
- State 2 uses of air

APPENDIX I11 A

PRE-SERVICE TEACHERS' INSTRUCTIONAL GUIDE FOR STAD GROUP INTERACTIVE STRATEGY STRATEGY 3

TOPIC: **Human body (blood circulation)**

CLASS: **Primary Six**

OBJECTIVES: **Students should be able to**

- **Define circulatory system**
- **Name the pumping organ**
- **Name the blood vessels**
- **Desirable the heart**
- **State 2 functions of blood**

DOMAIN: **Cognitive, Affective and Psychomotor**

Instructional Materials: biro tube, chart, blood sample, microscope, hand lens.

Strategy Prescription: STAD /GROUP INTERACTIVE TEACHING STRATEGY

Phases A – Introduction phase

Phase B – Transition to team phase

Step III: Teacher explain how STAD cooperative teaching strategy works and outlines specific procedures as follows:

Teacher's introductory statement and procedures on STAD Group interactive teaching strategy.

Pupils, I am going to divide you into the groups that you will be working with. Each group will have four members and four worksheets. Two members of each of the group will form a pair. Each person does his work and checks with his or her partner. If they agree and understand it, they move to the next problem, if they disagree they ask the other pair and all the four members discuss the problem until they are sure they understand it. But if the four members disagree they can ask me (the teacher)

Phase C - Team study phase

Step V: Teacher provide worksheet on the topic as follows:

Activity 1

- Identification of blood samples with microscope

- Naming the observed components of blood
- Observing the chart illustrating the structure of mammalian heart

Concept/ Fact

Activity 2

Remove the biro tube, put water in one hand. Collect the water from the other hand, then observe and reflect on what happens with reference to the pumping of blood

Concept/ Fact

Blood vessels are pipes through which the blood passes. In a mammals there are three blood vessels: arteries, veins and capillaries

Step VI: Pupils work in group

Step VII: Teacher monitors and provides assistance when necessary

Phase D – Assessment phase

Students answer the following questions

- What is blood circulation
- Name the four chambers of the heart
- Name the blood vessels

Phase E – Recognition of achievement phase

APPENDIX I11 B

PRE-SERVICE TEACHERS' INSTRUCTIONAL GUIDE FOR CONVENTIONAL STRATEGY 3

3B.

TOPIC: **Human body (blood circulation)**

CLASS: **Primary Six**

OBJECTIVES: **Students should be able to**

- **Define circulatory system**
- **Name the pumping organ**
- **Name the blood vessels**
- **Desirable the heart**
- **State 2 functions of blood**

DOMAIN: **Cognitive, Affective and Psychomotor**

Instructional Materials: biro tube, chart, blood sample, microscope, hand lens.

STEP I: Teacher introduces the lesson by defining blood circulation as the flow of blood form one part of the body to another.

STEP II: Teacher explains the vessels that carry blood round the body as follows:

- Arteries
- Veins
- Capillary

STEP III: Teacher states the importance of blood circulation.

- Transport foods
- Transport oxygen
- Transport hormones
- Act as body soldiers

STEP IV: Teacher describes the structure of the heart

- Heart has 4 chambers
- It is covered by pericardium

EVALUATION: Students answer the following questions

- What is blood circulation
- Name the four chambers of the heart
- Name the blood vessels
- What encloses the heart
- State 2 funtions of blood

. **APPENDIX IV**

TRAINING SCHEDULE FOR PRE-SERVICE TEACHERS

STEP I - Pre-service teachers are given a teachers' manual on the use of the strategy they have been assigned. [STAD/ GROUP INTERACTIVE STRATEGY].

STEP II - Research assistants, researcher and pre-service teachers discuss the strategies as outlined in the manual. Questions that may arise from the manual are answered.

STEP III - The research assistant/researcher explains the key components of PCK classroom practices to be observed as:

i. Orientation towards teaching science
ii. knowledge of students understanding science
iii. knowledge of science curriculum
iv. knowledge of assessment in science
v. knowledge of subject specific/topic specific strategy

STEP IV -Pre-service teachers are grouped in teams of 4 to 5 to demonstrate the strategy assigned to them.

STEP V -They teach specific topics using the strategy assigned to them in turns.

STEP VI -Research assistant makes a video recording of the activity in step V.

STEP VII -Pre-service teachers and research assistant make a critique of selected video tapes recorded in step V.

STEP VIII - for each video tape, they criticize the subcomponent of PCK classroom practices

STEP IX -Faults and difficulties are identified, problem areas are solved limitations are addressed and corrections made where necessary.

STEP X - Pre-service teachers do their presentations in turns for rating, grading and scoring. They are advised to do more practices in their leisure.

APPENDIX V

1.1 CoRe for Capturing PCK of Pre-service Teachers (in the Concept Air)

1. Air is everywhere around us.
2. Air is a mixture of gases
3. Component, of air are CO_2, O_2, N_2 and water vapour and noble gases.
4. Air cannot be seen, can be felt, necessary for burning/combustion, has weight.
5. Moving air is called wind.

6 Oxygen in air is used for breathing.

7. When a known weight of a deflated balloon is inflated and re-weighed the new weight shows the amount of air in the balloon

1.2 CoRe for Capturing PCK of Pre-service Teachers (in the Concept Force)

1. Force is any action like pushing or pulling
2. These actions help to move an object or change the speed and direction
3. Types of forces are contact and non-contact force
4. The force that pulls object in the air to the ground is collect gravitational force
5. Forces produced by charged forces are called electric force
6. Magnetic forces are demonstrated when a metal attracts other metallic or magnetic materials. Magnet can attract or repel depending on the environment.
7. A force that supports movement between two surfaces is called frictional force

1.3 CoRe for Capturing PCK of Pre-service Teachers (in the Concept of Human Body Circulation)

1. Blood flows through human body
2. The heart is the pumping organ of the body
3. The circulatory system consists of the heart and blood vessels
4. The blood vessels are arteries, veins and capillaries
5. The heart has 4 chambers, 2 auricles and 2 ventricles
6. Blood carries important substances from one part of the body to another
7. Blood helps to cool the body during sweating

1.4 Important Science Ideas on Air (CoRe)

1.	What you intend the students to learn about this idea	Air is everywhere around us in air	Air is a mixture of gases	Component, of air are CO_2, O_2, N_2 and water vapour	Air can be seen, felt, necessary for burning/combustion has weight	Moving air is called wind	Air is used for breathing	When a known weight of a deflated balloon is inflated and re-weighed the new weight shows the amount of air in the balloon
2.	Why it is important for students to know this	Because it helps to explain the presence of air	It explains what air is made up	Because it identifies the various sub-component of air in terms of gases	Because it explains the properties of air	It distinguishes between air and wind	Because it explains what air is used for	It demonstrate an activity to show that air has weight
3.	What else you know about this idea that you do not intend students to know yet	Gravitational pressure pulls substance down when placed in air	Relative percentage of these gases	Represent the component in symbols e.g O_2, CO_2 etc	Gras law and the kinetic theory of motion	Instrument for measuring the direction and speed of wind	Mechanism of respiration in animals	Boyle's law which relates the volume and pressure

4.	Difficulties/limitation associated with this idea	Air cannot be seen	Explaining the difference between a mixture and compound with reference to gases	That the compound can be isolated and separated from the "whole"	----	----	----	Students might loose focus with balloon as instrumental material
5	Knowledge about student thinking which influences your teaching of this idea	Many students don't know air exist	The believe of many students is that gases cannot mix together		Many students believe air has no weight since they cannot see it	Air and wind have no relationship		Many students have no prior knowledge of the demonstration
6	Other factors that influence your teaching of this idea	Maturity stage of student and psychological development	Ability and readiness to grasp abstract ideas	Age and intelligent quotient of majority of the students in		It is observable but students may often take it for	The students level of understanding	Knowledge is retained when practically demonstrated

				the class		granted		
7	Teaching procedures lend particular reasons for using these to engage with this idea	Group interactive teaching strategy	Probes students thinking	Increases the students understanding	Enhances student view on the concept of air and its properties	Group interactive instructive strategies	Further uncover individual students views on air	Demonstration increases students hand-on most on activities

1.5 **Important Science Ideas on Force (CoRe)**

1.	What you intend the students to learn about this idea	Force is any action like pushing or pulling	These actions helps to move an object or change the speed and direction	Types of forces are contact and non-contact force	The force that pulls object in the air to the ground is collect gravitational force	Forces produced by changed forces are called electric force	Magnetic forces are demonstrated when a metal attract the metallic or magnetic materials	Force that support movement between two surfaces is called frictional force
2.	Why it is important for students to know this	Because if helps to explain the concept of pull/push	Because it explains ability to move things on change the direction of object	Because it distinguish between the type of forces	Because it explains the force in the air	Because it relates to electric shock which student, are female with	Because it links forces to magnetic and non magnetic metals	Because it explain the grip that hold two surfaces
3.	What else do you know about this idea (that you do not intend students	Equation and laws of force e.g Newton is the unit of force	The concept of force x distance = acceleration	Details of contact and Non-contact force e.g magnetic pull	----	-----	------	Details of frictional force and its application

	to know yet)							
4.	Difficulties limitation connected with teaching this idea	Distinguishing between push & pull	-----	------	That some substance float in air e.g movement of aeroplane	Students can mis-understand the concept of electric stock and electric force	-----	Explaining the concept to the best understanding of students
5.	Knowledge about students thinking which influences your teaching of this idea	They push and pull everyday	Students unconsciously are aware of what a force can do	------	The movement of aeroplane in air	Students see electric cables and wires as them matter of current	Students use magnet and non magnet as toys	-----
6.	Other factors that influence your teaching of this idea	Age and level of understanding of students	Readiness to learn new ideas on force	Ability of students to differentiate between types of forces	Curiosity of student	Students went to know hinted electric wire causes as hock	Interest of students in magnets	Maturity of students
7.	Teaching procedures and particular	Group interactive teaching	Group interactive teaching	Group interactive teaching	Group interactive teaching	GROUP interactive teaching	Group interactive teaching	Group interactive teaching strategies

	reasons for using these to engage with this idea	strategies	strategies	strategies	strategies	strategies	strategies	

1.6 Important Science Ideas on Human Body Circulation (CoRe)

1.	That the blood moves round the body	Organ responsible for this flow is the heart	There are pipe-like structures called vessels	Identification of the blood vessels	Structure of the heart	What the blood does	What the blood does during sweating
2.	Because it explains the body mechanism	Because it explains the organ of flow	Because it explains the medium of blood flow	It explains different types and blood vessels	It describes the heart	Because it explains how substances are transported	Because it explains the process of cooling the body
3.	Systemic and palmary circulation	Diagram of the heart and its labels	Double and single blood circulation	Mechanism of blood flow through the vessels	Direction of blood flow in the heart	Details of blood transportation	Process of excretion through the skin
4.	---	How to draw & describe the heart	----	Differentiating between arteries, veins and capillaries	----	------	Differences between excretion and circulation
5.	Many students know then is blood	Students have seen the heart of lower animals	-----	Students assume the vessels to look like pipes	-----	Blood helps in circulation of materials	Many students sweat

6.	Maturity of Students	Age-aunt of students	Readiness of student learn	----	Maturity of students	-----	Physiological development of students
7.	Constructivist feeling strategy	Constructivist teaching strategy	Constructivist	Constructivist strategy	Constructivist strategy	Constructivist strategy	Constructivist strategy

APPENDIX V1

PCK MEASUREMENT SCALE FOR PRE-SERVICE TEACHERS

S/N	ITEMS	SA	A	D	SD
	TEACHING KNOWLEDGE/PEDAGOGY				
1.	I have knowledge about the context of my lesson.				
2	I use teaching methods and techniques suitable for the topic.				
3	I can use different presentation techniques appropriate for the topic.				
4	I know which teaching method and techniques to use for the topic.				
5	I can control negative situations while teaching				
	KNOWLEDGE OF SUBJECT MATTER				
6	I know the basic definitions in my lesson				
7	I have knowledge about relation, rule and formula in my lessons				
8	I can select problems suitable for teaching contexts in my lesson				
9	I can develop measurements and assessment tools suitable for the topics				
	KNOWLEDGE OF LEARNERS				
10	I can realize and meet the difficulties of students during my lesson				
11	I can prepare an appropriate lesson plan in accordance with the point that students may be pressured in my lessons				
12	I can notice misconceptions of students in the course of teaching a new topic				
13	I can organize a suitable learning environment for students				
14	I can begin different activities which to motivate students for lessons				
15	I know how to assess students' performance in the classroom				

APPENDIX V

TEACHERS SELF EFFICACY SCALE

The questionnaire is designed to help us gain a better understanding of the knowledge of things that create difficulties for teachers in the school activities. Please kindly indicate your opinion about each of the statement below by circling the appropriate one. Your answer will be kept strictly confidential and will not be identified by name.

1. **Efficacy to influence decision.**

How much can you influence the decision that are made in the school

1	2	3	4
Nothing	Very little	quite a bit	a great deal

How much can you express your views freely on important school matter?

1	2	3	4
Nothing	Very little	quite a bit	a great deal

How much can you do to influence the class size on your school?

1	2	3	4
Nothing	Very little	quite a bit	a great deal

2. **Efficacy to Influence school resources**

How much can you do to get the instructional materials and equipment you need?

1	2	3	4
Nothing	Very little	quite a bit	a great deal

How much can you make use of science kits

1	2	3	4
Nothing	Very little	quite a bit	a great deal

3. **Instructional self- efficacy**

How much can you do to get through to the most difficult students?

1	2	3	4
Nothing	Very little	quite a bit	a great deal

How much can you do to promote learning when they are lack of support from the home?

1	2	3	4
Nothing	Very little	quite a bit	a great deal

How much can you do to keep students on tasks or different assignment?

1 2 3 4

Nothing Very little quite a bit a great deal

How much can you do to increase student memory of what they have learnt or taught?

1 2 3 4

Nothing Very little quite a bit a great deal

4. Disciplinary self- efficacy

How much can you do to get the children follow classroom rules?

1 2 3 4

Nothing Very little quite a bit a great deal

How much can you do to control disruption behavior in the classroom?

1 2 3 4

Nothing Very little quite a bit a great deal

How much can you do to prevent problem behavior on the school compound?

1 2 3 4

Nothing Very little quite a bit a great deal

5. Efficacy to enlist parental involvement

How much can you do to get parents to get involved in school activities?

1 2 3 4

Nothing Very little quite a bit a great deal

How much can you do to assist parents in helping the child do well in school?

1 2 3 4

Nothing Very little quite a bit a great deal

6. Efficacy to create positive school climate

How much can you do to make the school a safe place?

1 2 3 4

Nothing Very little quite a bit a great deal

How much can you do to make students enjoy coming to school

1 2 3 4

Nothing Very little quite a bit a great deal

APPENDIX VI1

Measurement Scale for Pupils Self-Efficacy

S/N	ACTIVITY	THEORETICAL BASIS	SA	A	D	SD
1.	Soon after the end of a lesson, I am able to remember (most, all) of the key concepts	Remembering				
2.	I can understand (most, all) of the kv ey concepts covered in my course					
3.	I am able to explain to my fellow students, in a way they can understand, (most, all) of the key concepts in a course					
4.	After sitting an exam, I am able to remember (most, all) of the key concepts covered in the course					
5.	I am able to organize my activities so that I can meet (most, all) course deadlines	Organization				
6.	Even when I haven't participated in a lesson, I can (usually, always) understand the concepts covered in the lesson by reading a text book					
7.	I am (usually, always) able to find material in the library about a subject that interests me					
8.	I am always able to find more detailed information on the internet for a topic that (interests me, does not interest me at all)					
9.	I am (usually, always) able to identify the most appropriate person to help me resolve a problem related to my study	Explanation				

10.	I am (usually, always) able to evaluate the quality of fellow group members' contributions when I participate in group activities					
11.	I am (usually, always) able to relate the notes I have made during a lesson with the topics covered in the course text or messages	Understanding				
12.	It is (usually, always) easy for me to understand new information, even on a topic that does not interest me very much					
13.	When I find something new about a topic that I am studying, I am (usually, always) able to connect it with other things that I know about the topic	Connecting				
14.	It is (usually, always) easy for me to connect new information about a topic that interests me with other pieces of information					
15.	During a course, if we are given a new task to complete, I can (usually, always) complete it by applying the knowledge that I obtained from lessons					
16.	Soon after the end of a lesson, I am (usually, always) able to distinguish the most important concepts from concepts of less importance					
17.	I (usually, always) find it easy to join a group of fellow students to study or complete course activities	Updating				
18.	I am (usually, always) able to identify useful information on the web for an					

	easy					
19.	I am (usually, always) able to use the library and library services to select appropriate books and articles for an easy					
20.	After a lesson, I am (usually, always) able to integrate concepts described by the teacher with those presented in course texts and readings					

APPENDIX VII1

BASIC SCIENCE ACHIEVEMENT TEST (BSAT)

OBJECTIVE TESTS

1. ____ is any action that helps to move an object (a) force (b) magnet (c) push (d) pull
2. Friction is an example of a _____ force (a) contact (b) non-contact (c) energetic (d) electric force
3. We use ____ to change the shape of a body (a) magnet (b) force (c) lens (d) paper
4. ____ force works with charges (a) magnetic force (b) electrical (c) gravitational (d) cylindrical
5. Which of these is not a metal (a) iron (b) nails (c) wood (d) tin
6. _____ covers the heart (a) pericardium (b) ventricles (c) veins (d) blood
7. _____ is a pumping organ (a) nose (b) heart (c) lungs (d) ear
8. The heart has _____ chambers in man (a) 4 (b) 2 (c) 3 (d) 1
9. Which of these is not a blood vessel (a) arteries (b) veins (c) capillaries (d) ventricle
10. _____ is a mixture of gases (a) air (b) weight (c) pressure(d) temperature
11. Air has weight and occupies _____ (a) scale (b) earth (c) space (d) man
12. Air helps birds to _____ (a) eat (b) fly (c) reproduce (d) mate
13. Moving air is called _____ (a) pressure (b) wind (c) kite (d) drone
14. Substances that have the capability of attracting specific materials are called _____ (a) metals (b) magnet (c) pressure (d) pump
15. _____ oppose movement between two surfaces (a) metal (b) gravity (c) magnet (d) friction
16. Which is heavier 2kg of cotton wool or 2kg of yam (a) cotton wool (b) bag of rice (c) a and b (d) none
17. Blood carries _____ to all the body cells (a) CO_2 (b) O_2 (c) water (d) air
18. --------- blood cells act as body soldiers (a) white (b) red (c) pink (d) blue.
19. A parachute uses _____ to fly (a) water (b) liquid (c) air (d) sea
20. The _____ in air can uproot a tree (a) water (b) force (c) acid (d) wood.

APPENDIX 1X

MARKING GUIDE FOR BASIC SCIENCE ACHIEVEMENT TEST

1. A
2. A
3. B
4. B
5. C
6. B
7. B
8. A
9. D
10. A
11. C
12. B
13. B
14. B
15. D
16. D
17. B
18. A
19. C
20. B

APPENDIX X

PRE-SERVICE TEACHERS PCK CLASSROOM PRACTICES

OBSERVATION SCALE

NAME OF STUDENT _____

YEARS OF TEACHING EXPERIENCE _____

SUBJECT: _____ YEARS OF STUDY _____

TOPIC TAUGHT: _____

CLASS TAUGHT: _____ TIME: _____

DATE: _____

TEACHING PRACTICE SCHOOL: _____

Items/Lesson Features	**Rating**	**Visits**			**Average score**	**Remark**
Orientation towards teaching science Lesson preparation	5 4 3 2 1 0					
Teaching aids/resources	5 4 3 2 1 0					
Teachers personalities	5 4 3 2 1 0					
Comportment/Language	5 4 3 2 1 0					
Knowledge of Science curriculum						
Knowledge of syllabus	5 4 3 2 1 0					
Interpretation of scheme of work	5 4 3 2 1 0					
Adequacy of lesson plan	5 4 3 2 1 0					
Adequacy of Behavioral objectives	5 4 3 2 1 0					
Knowledge of student understanding						
Previous knowledge of students	5 4 3 2 1					

	0					
Students prior knowledge	5 4 3 2 1 0					
Students participation	5 4 3 2 1 0					
Class control	5 4 3 2 1 0					
Knowledge of topic/subject specific strategies						
Appropriate use of strategy	5 4 3 2 1 0					
Relevance of strategy	5 4 3 2 1 0					
Suitability	5 4 3 2 1 0					
Effectiveness	5 4 3 2 1 0					
Knowledge of assessment in science						
Stability of assessment	5 4 3 2 1 0					
Face and content facility	5 4 3 2 1 0					
Distribution of questions	5 4 3 2 1 0					
Attainment of objectives	5 4 3 2 1 0					
Total marks 1000						

ADDITIONAL COMMENT(S)

_____

_____

_____ _____

Name and Signature of Supervisor ***Date***

APPENDIX X1

ATTITUDE TO SCIENCE QUESTIONNAIRE

S/N	ITEMS	SA	A	SD	D
1	I am amazed by the achievement of science				
2	Science is such a big part of our lives that we should all take an interest				
3	It is important to know about science in my daily life				
4	Science and technology are too specialized for most people to understand it				
5	I don't think I'm clever enough to understand science and technology				
6	I don't understand the point of all the science being done today				
7	Science is my favourite subject				
8	I enjoy science because of the method of teaching				
9	I would like to continue my studies in science subject				
10	I have more interest in science				

APPENDIX X11

STRUCTURED INTERVIEW QUESTIONS

PCK

– What do you understand by pedagogical content knowledge PCK

– Do you take methodology courses in your NCE programme?

–. Did you participate in the teaching practice exercise (EDU 324) which is a compulsory course to be held in 300 level of the NCE curriculum?

– Was your PCK developed during your teaching practice?

– Do you think there is a difference between subject matter knowledge and PCK ?

– Reflect deeply on your experiences in the training programme to develop you PCK; what can you say about the theory and Practice of teaching Basic science particularly in primary school?

– What major challenges about science teaching was corrected after your PCK development training programme.–

SELF-EFFICACY

- How can you rate your self- efficacy after the training?

– what aspect of self- efficacy was enhanced by the training?

– How do you see yourself as a teacher?

-Describe tour experience before and after training with Group interactive strategy.