EFFECTS OF ACTIVITY-BASED STRATEGIES ON PRIMARY SCHOOL MATHEMATICS LESSON PLAN AND DELIVERY SKILLS AMONG PRE-SERVICE TEACHERS IN SOUTHWESTERN NIGERIA

By

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ABSTRACT

Activity-based instructional strategies have been identified as being effective in the delivery of rule-governed subjects such as Mathematics. Two of these strategies are the Pupil-centred Activity-based Instructional Strategy (PAIS) and Teacher Demonstration Activity-based Strategy (TDAS). However, research findings have shown that a large number of primary school mathematics teachers trained in colleges of education in Nigeria have difficulty in developing lesson plans and delivering activity-based mathematics lessons. Past studies on activity-based strategies have focused on the general effectiveness of such strategies but have not sufficiently covered the skills of planning and delivery of lessons among the pre-service primary teachers. This study, therefore examined the effects of activity-based strategies on the primary mathematics lesson plan and delivery skills among pre-service teachers. The moderating effect of teachers' numerical ability and gender were also examined.

Pretest-posttest control group quasi-experimental research design was adopted for this study. The participants were 337 pre-service primary Mathematics teachers in three colleges of education in Southwestern Nigeria. Pupil-centred activity-based, teacher demonstration activity-based and conventional strategies were assigned to experimental-group I, experimental-group II and control group respectively. The study lasted 15 weeks for teaching and observation. Pre-Service Teachers Activity-Based Lesson Plan Scale (r = 0.84); Activity-Based Lesson Utilisation Scale (r = 0.79); Primary Numerical Ability Test (r = 0.83) and three instructional guides were the research instruments used. Eleven hypotheses were tested at 0.05 level of significance. Data were analysed using Analysis of Covariance, Analysis of Variance and Scheffe's Post-hoc tests.

There was a significant main effect of treatment on pre-service teachers' lesson plan skills ($F_{(2,318)}$ = 628.15; $p<0.05$; partial η^2 = .80). Pre-service teachers exposed to TDAS had a higher activity-based lesson plan score ($\bar{x}$ = 61.73) than those exposed to PAIS ($\bar{x}$ = 55.37) and those exposed to conventional strategy ($\bar{x}$ = 11.32). There were no significant main effects of numerical ability and gender on pre-service teachers' lesson plan skills. There was significant difference between the treatment groups in primary Mathematics activity-based lesson delivery skills ($F_{(2,\ 298)}$ = 63.63; $p<0.05$; partial η^2 = 0.30). Those exposed to PAIS had higher activity-based lesson delivery score ($\bar{x}$ = 59.4) than those exposed to TDAS ($\bar{x}$ = 49.7) and those exposed to conventional strategy ($\bar{x}$ = 46.2). There were no significant main effects of numerical ability and gender on pre-service teachers' mathematics lesson delivery skills. Generally, these results imply that TDAS enhanced primary Mathematics activity-based lesson plan skills while PAIS enhanced the lesson delivery skills.

Pupil-centred and teacher demonstration activity-based strategies enhanced pre-service primary mathematics teachers' lesson plan and delivery skills more than the conventional strategy. Lecturers of primary school mathematics methodology courses in the colleges of education should be encouraged to acquire and utilise activity-based skills. Also, the contents of primary school mathematics methodology courses should include planning and delivery of the two strategies.

Key words: Pupil-centred activity-based strategies, Teacher demonstration strategy, Pre-service primary mathematics teachers, Numerical ability, Lesson plan and delivery skills.

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CERTIFICATION

I certify that this study was carried out by **Ishola Akindele SALAMI** under my supervision in the Department of Teacher Education, Faculty of Education, University of Ibadan, Nigeria.

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ABBREVIATIONS

1. **ABLPF:** Activity-Based Lesson Plan Format
2. **ABLUS:** Activity-Based Lesson Utilization Scale
3. **ATABLQ:** Attitude towards Activity-Based Lesson Questionnaire
4. **CIS:** Conventional Instructional Strategy
5. **CISG:** Conventional Strategy Instructional Guide
6. **NCE:** Nigeria Certificate in Education
7. **PAIS:** Pupil-Centred Activity-Based Instructional Strategy
8. **PABIP:** Pupil-Centred Activity-Based Instructional Package
9. **PABIP-VT:** Pupil-Centred Activity-Based Instructional Package Validation Tool
10. **PES:** Primary Education Studies
11. **PNAT:** Primary Numerical Ability Test
12. **PSTABLPS:** Pre-service Teacher Activity-Based Lesson Plan Scale
13. **TDAS:** Teacher Demonstration Activity-Based Strategy
14. **TDIP:** Teacher Demonstration Instructional Package

CHAPTER ONE

INTRODUCTION

1.1 Background to the Problem

Education, as the means of acquiring knowledge, skills and attitude, is as old as man and up till today, the struggle to make education effective and available for all is always the priority of every nation. The only way by which the younger generation could be integrated into the society in order to sustain and improve upon development is either through formal, informal or non-formal education. Any of these forms of education relies heavily on the human teacher for its effectiveness. This, in effect, means that any effort towards improving teacher effectiveness is tantamount to an effort to improve the effectiveness of the educational system and this should be the concern of every nation (Amobi, 2006). That is perhaps why Anderson (2004) submits that education for all is good, but good quality education for all is what is worth planning for.

Knowledge, which is regarded as an important product of education, is acquired in various ways. It could be through reading of books, experimenting, searching the internet, direct or indirect instruction and so on. The most common and generally accepted way is the knowledge acquired through instructions. In this regard, it seems an individual, in most part of the world, is considered to be deficient if such a person has no opportunity to experience formal education in which learning through instructions permeates. The teaching process, through any methodology or strategy, has been recognized for centuries as an important, inevitable and effective means by which knowledge could be imparted and acquired effectively (Abimbola, 2001; Parkay and Standford, 2004; Teacher Registration Council of Nigeria {TRCN}, 2004; Moronkola 2011; Osanyin and Adebayo, 2011). The teaching process could then be said to be as effective as the teacher. Whether students learn or not depends, to a great extent, on the teacher.

Studies have shown that teacher effectiveness as a variable is a strong determinant of differences in students' learning. The consequence of teacher effectiveness as a variable is often gravely felt, much more than the effect of any other school-related variables, on the students' learning outcome (Sanders and Rivers, 1996; Darling-Hammond, 2000; Cruickshank, Jenkins and Metcalf, 2003; Eggen and Kauchak, 2006; Opara and Faloye, 2011; Osanyin and Adebayo, 2011; Njeru, 2012). Therefore, the training of teachers is given a paramount place in every society (Awolola and Fabunmi, 2012; Njeru, 2012). UNESCO (1998), in the World Declaration on Higher Education, Article 1, section F, submits that higher education must contribute to the development and training of teachers. The Federal Government of Nigeria has also made it clear in the National Policy on Education that no educational system can rise above the quality of the teachers (Federal Government of Nigeria {FGN}, 2004). This reveals the need to train and retrain teachers. This is why teacher education is considered vital in curriculum development and instructions (Moronkola, 2011).

Some of the goals of teacher education in Nigeria are to produce highly motivated, conscientious and efficient classroom teachers for all the levels of educational system; to provide teachers with the intellectual and professional background adequate for their assignment and make them adaptable to changing situations (FGN, 2004; Opara and Faloye, 2011). These goals are in line with world declaration on higher education as enunciated by UNESCO (1998). They are also in tandem with the goal of U.S. Department of Education (2003) and the study of Parkay and Stanford, (2004). The type of teachers envisaged by these policy makers is what Anderson (2004) termed 'effective teacher'.

According to Anderson, effective teachers are those that possess the knowledge and the skills needed to attain the desirable educational goals, and are able to use the acquired knowledge and skills appropriately if these educational goals are to be achieved. Medley (1982) called this type of teachers 'competent teachers' because effective learning is a product of effective teaching which can only be given by an effective teacher who is considered to have, not only the knowledge of the subject matter, but also possesses the teaching skills (Amobi, 2006).

Curzon (1985) submits that one of the functions of the teacher, which makes him effective, is not just to impart information and hope that it will be received and retained, but also to understand and plan those conditions and activities which will result in effective learning. Anderson (2004) notes that students' learning depends on the activities they do and less of what the teacher does. From the foregoing, it can be said that learning is best achieved when learners are actively involved in the learning activities. For such learning to occur, teaching has to be well planned, organised and resources used effectively.

A closer examination of primary mathematics teaching and in the present time, especially at the basic education level, has become a source of great concern to mathematics educators and scholars. The subject has been identified as the most disliked subject in school (FGN/UNICEF/UNESCO, 1997; Brown, Brown and Bibby, 2008) with students' performance worsening from year to year at all levels of education (Aremu, 1998). Research findings in Nigeria have shown that the performance of pupils in primary Mathematics is below average and, also, that the problem solving skills of the pupils is poor. In a report prepared by Nigeria Education Sector Analysis (ESA, 2004), the national percentage mean scores of primary four and six pupils in numeracy are put at 33.7 and 35.7 respectively. Table 1.1 below presents the detailed information about the performance of pupils in Mathematics across the nation according to that report.

Table 1.1: Performance in Numeracy Test by States (Including Abuja) and Class

S/N	STATE	PRY IV	PRY VI	S/N	STATE	PRY IV	PRY VI
1	ABIA	27.63	-	20	KANO	36.51	35.71
2	ABUJA	28.33	37.67	21	KATSINA	29.85	27.64
3	ADAMAWA	22.93	27.32	22	KEBBI	41.43	45.54
4	AK.IBOM	28.29	27.7	23	KOGI	32.2	36.55
5	ANAMBRA	31.04	39.24	24	KWARA	32.59	-
6	BAUCHI	45.5	35.33	25	LAGOS	32.54	37.76
7	BAYELSA	22.61	43.12	26	NASARAWA	25.4	25.39
8	BENUE	40.78	54.82	27	NIGER	32.65	31.57
9	BORNO	19.32	20.85	28	OGUN	49.27	46.51
10	C/RIVER	34.4	31.42	29	ONDO	35.03	33.09
11	DELTA	30.46	22.48	30	OSUN	32.4	28.96
12	EBONYI	20.21	22.48	31	OYO	36.41	41.65
13	EDO	33.64	28.64	32	PLATEAU	29.11	29.24
14	EKITI	35.63	39.67	33	RIVERS	-	27.78
15	ENUGU	48.8	38.72	34	SOKOTO	27.77	30.91
16	GOMBE	36.71	34.68	35	TARABA	45.15	44.73
17	IMO	26.32	30.58	36	YOBE	39.28	40.67
18	JIGAWA	46.35	45.07	37	ZAMFARA	33.17	34.35
19	KADUNA	47.75	48.31				

SOURCE: Nigeria Education Sector Analysis (ESA, 2004)

Table 1.1 reveals that primary 4 pupils in Ogun State had the highest mean percent score of 49.27 while pupils in Borno State had the lowest mean percent score of 19.32. Primary 6 pupils in Benue State had the highest mean percent score of 54.82 while primary 6 pupils in

Delta and Ebonyi States had the lowest mean percent score of 22.48. Generally, it is clear from the table that neither the state nor the national mean score is up to 60% in primary Mathematics.

Again, the National Assessment of the Universal Basic Education Programme presented the performance of primary six pupils across the nation in 2009. The results shows that only three states out of the thirty-six states and the Federal Capital Territory have average scores that is up to average- Bayelsa State (Mean = 55.96%), Jigawa (mean = 58.26%) and Osun (mean = 54%). Fifteen states have mean scores that is not up to pass mark. Their scores range from 23.35% for Kano State to 29.23% for Ondo state. The national mean score is 42.87% which is below average (NAUBEP, 2009).

Considering the status and the importance of Mathematics in various spheres of our national life, this poor teaching/learning situation associated with it should not be allowed to continue. Today, technology is the mainstay of any societal development and Mathematics has been recognised as the bedrock of technology and sciences (Ogunsanwo, 2003; Adeyemo and Adetona, 2007; Awofala, 2008; Rasheed, 2008). In fact, we are at an age where no human endeavour could survive or develop without the application of Mathematics and/or technology since almost all kinds of job have been computerized. Apart from this, the subject develops the computational skills of the pupils, skills for solving the day-to-day problems that require mathematical knowledge. It forms the basis for further education in almost all fields of study in all higher institutions (Tella, 2009). The economic development also has its root in the mathematical competence of the stakeholders (Ogunsanwo, 2003). Therefore, all hands must be on deck to ensure effective teaching of the subject at the primary school level where solid foundation for further studies in Mathematics, Sciences and Technology could be laid. This is why a study of this nature is very important. This study would introduce pre-service teachers to certain mathematics concepts using two modes of activity-based instructional strategies. These are Pupil-Centred Activity-Based and Teacher Demonstration Instructional Strategies. The effects on the student's acquisition of skills needed to design activity-based lesson plans and utilise the strategy would be measured. It is believed that pre-service teachers will be able to teach using Activity-Based Strategy, if they are adequately exposed to the strategy by being taught using the strategy. This is predicated on the premise that we teach the way we were taught (Akinbote, 1999; Cruickshank; Jenkins and Metcalf, 2003; Khazanov, 2007).

An exploratory feasibility study was carried out by the researcher in some Colleges of Education in south west part of Nigeria. Out of the eleven (11) government owned colleges in this part of the country, six of them were randomly selected and visited. The findings from these visitations are tabulated below.

Table 1.2: Summary of Feasibility Study on Colleges of Education, South Western States, Nigeria

S/N	Name of College	No. of PES 122 Student	Source of Lecturer	Common Method of Teaching
1	Adeyemi College of Educ. Ondo	16	ECE Dept. (adjunct lecturer)	Highly Modified Lecture method
2	Michael Otedola Collg. of Primary Educ. Epe	30	Maths Dept. (adjunct lecturer)	Slightly Modified Lecture method
3	Tai Solarin Collg. Of Educ. Omu-Ijebu	15	GSE Dept (adjunct lecturer)	Slightly modified Lecture method
4	Emmanuel Alayande Collg. Of Educ. Oyo	200+	PES Dept.	Highly Modified Lecture method
5	Federal College of Educ. Osiele, Abeokuta	81	GSE Dept. (adjunct leturer)	Slightly modified Lecture method
6	Adeniran Ogunsanya College of Education, Oto, Ijanikin	150	PES Dept.	Highly modified Lecture method

Table 1.2 reveals that majority of those teaching primary mathematics methodology courses are adjunct lecturers (66.7%) and they all use slightly-modified lecture method of teaching, except some (40%) that use highly-modified lecturer method. None of these teachers was found using Students-Centred or any Activity-Based Instructional Strategy. The result of this exploratory study shows that pre-service teachers are not being taught with the strategies that would help in achieving the goals of primary education and, in particular, primary mathematics education.

Two of the cardinal goals of primary education, as stated in the National Policy on Education (FGN, 2004) section 4, number 18a and b are: the inculcation of permanent literacy and numeracy; and the laying of a sound basis for scientific and reflective thinking. This cannot be achieved without Mathematics since the subject is the essential nutrient for thought, logic, reasoning and, therefore, progress. Its abstract nature has, however, been a great challenge for teachers. However, with the application of the right strategies, Mathematics could be demystified. Two of such strategies are the Pupil-Centred Activity-Based and Teacher Demonstration Instructional Strategies which are the two forms of activity-based method of teaching (Loeffler, 2010). These two strategies encourage pupils to learn Mathematics through adequate use of manipulative materials. The former (Pupil-Centred Activity-Based) is more effective when the size of the class is small and there are enough materials to go round the students (Engel, 2002) while the latter (Teacher Demonstration) is more effective when the size of the class is large and there are no enough materials to go round the learners (Loeffler, 2010). Teachers, especially primary mathematics teachers, must be able to design, plan and implement these strategies in order to impart effective mathematical skills, knowledge and understanding to the pupils at any of these situations. This study intends to achieve this by using Pupil-Centred Activity-Based and Teacher Demonstration lesson plan formats as models for the preparation of pre-service teachers who are expected to teach Mathematics in primary schools after graduation.

The problem associated with teaching/learning Mathematics at all levels of education in Nigeria today stems from the ineffective teaching of the subject right from the primary school. In addition to this is the non-provision of activity-oriented and pupil-centred lesson which could demystify the teaching and learning of the subject (Adegboye, 1999, Akinsola, 1999, Amobi, 2006; Adeyemo and Adetona, 2007). It is important to note here that using concrete instructional material is the major attribute of activity-based instructional strategy. Using it in mathematics lesson is important because of the advantages it could bring into learning the subject, such as changing the trend of poor performance and low interest in the subject which currently characterise Nigerian primary schools today. But there are two ways by which materials could be used to teach Mathematics. These materials could be provided for the learners to explore, hence the basis for Pupil-Centred Activity-Based. When the number of materials is not enough to go round the number of learners, a teacher could resort to demonstrating with the materials for learners to observe. In this case, it is called teacher demonstration instructional strategy.

Pupil-centred Activity-based Instructional Strategy (PABIS) facilitates the learning of new skills, knowledge acquisition and gaining of experience through active participation of learners in the process of knowledge acquisition (Richardson, 1997; The Ontario Curriculum Unit Planner, 2002; Reshetova, 2004). Many research findings have shown that this type of activity-based instructional strategy is very effective for teaching abstract subjects such as Mathematics (Suydam and Higgins, 1977; Walkerdine, 1982; Wearne and Hiebert, 1988; Stigler and Baranes, 1988; Fuys, Geddes, and Tischler, 1988; Sowell, 1989; Fuson, 1992; Thompson, 1992; English and Halford, 1995; The Ontario Curriculum Unit Planner, 2002; Macdonald and Twining, 2002; Reshetova, 2004; Dada, Granlund and Alant, 2006; Epstein, 2007; Marley, Levin and Glenberg, 2010). Engel (2002) sums this up by saying that Activity-Based Strategy may meet all the major demands that apply to present day Mathematics, such as preparing students to represent and analyze real situations, solving problems, making decisions using mathematical reasoning, communicating their thinking and making connections. Jensen (2008) confirms that not only do children learn by doing and that movement is the child's preferred mode of learning but also that physical activity activates the brain much more than doing seatwork. While sitting increases fatigue and reduces concentration, movement feeds oxygen, water, and glucose to the brain, optimizing its performance. Furthermore, learning by doing creates more neural networks in the brain and throughout the body, making the entire body a tool for learning (Hannaford, 2005). Marley, Levin and Glenberg (2010) affirm that motor memory system is present in activity-based strategy that provides an additional pathway for the encoding and retrieval of target information to and from long-term memory. Active learning is also more fun for young children, which means it matters more to them (Pica, 2008).

One-way mathematics instruction is like a room painted and furnished in one dark colour, dull and obscure. Planning for a dynamic mathematics instruction enables us to accommodate the needs of all the learners (Martinez and Martinez, 2007). English and Halford (1995), looking at it from the primary level of education, said it could help pupils understand mathematical concepts and processes and increase their flexibility of thinking. They also said that it could be used creatively as tools to solve new mathematical problems while reducing pupils' anxiety in the course of doing Mathematics. Sowell (1989) relates it with academic achievement and said, 'Mathematics achievement is increased through the long-term use of concrete instructional materials and that students' attitude toward Mathematics are improved when they have instruction with concrete materials provided by teachers knowledgeable about their use' (pg 498).

Adeyemo (1979) submits that children learn a little by listening and by watching but they learn much by actually doing the piece of work. Pupil-centred activity-based instructional strategy is meant to facilitate learners' active participation in the learning process. In such a lesson, learners engage in activities that are: (i) children initiated; that is, activities that are built upon the natural curiosity of children and (ii) developmentally appropriate, for the children's current and emerging abilities (The Ontario Curriculum Unit Planner, 2002; Epstein, 2007). National Association of Education of Young Children (NAEYC, 2009) added that it makes activities and mathematics concepts socially and culturally appropriate.

Teacher Demonstration Activity-Based Strategy (TDAS) helps learners to view a real or lifelike example of a skill or procedure to be learnt (Loeffler, 2010). It has been described as a method of teaching that relies heavily upon showing the learner a model performance that he should match or pass after he has seen a presentation that is live, filmed or electronically operated (Rodriques, 2010). Demonstration Instructional Strategy facilitates faster and more effective learning. Students are shown how the work is done by using the actual tools and materials they are expected to work with. Unlike Pupil-centred Activity-Based, it does not require large quantity of materials (Rodriques, 2010). This is likely to be helpful in the Nigerian situation where there are large classes and materials are not available. Since the learners, is the focus of this study, are the pupils in primary school, this strategy also allows teacher to control potentially dangerous materials or materials which pupils can turn to dangerous use (Loeffler, 2010).

Teacher's lesson plan, most of the times, dictates the mode of presentation the lesson will take (Kellough and Kellough, 2007). Arends (2004) submits that daily plans can take many forms and that the features of a particular lesson often determine the lesson plan format. He explains further that different lesson methods or strategies have their respective different lesson plan format. Lesson plan can also determine whether the learning would be effective or not because it dictates what happens and how it happens during the lesson (Arends, 2000; Copley 2000; Kellough and Kellough, 2007; Bahr and Garcia, 2010).

Some scholars have observed that pre-service teachers in Nigeria are often taught using lecture method, and the lesson format they are exposed to is teacher-centred (Olosunde, 2009; Salami, 2009). Since we teach the way we have been taught (Akinbote, 1999; Cruickshank; Jenkins and Metcalf, 2003; Khazanov, 2007), it has, thus, become difficult, if not impossible, for the product of our teacher education programmes to plan and present mathematics lesson in such a way as to facilitate pupils' active involvement.

Many scholars, governmental and non-governmental organizations, and other stakeholders in the education sector have observed the shortcomings of teacher preparation programmes in Nigerian teacher-training institutions and have started various intervention programmes. For instance, Omosehin (2004) trained pre-service teachers on the use of Cooperative Learning (CL) in teaching Social Studies. The Federal Government of Nigeria, in collaboration with the National Teachers Institute, since the year 2006, started to organise workshops to update primary school teachers on effective ways of carrying out their functions across the whole country. Teacher Education in Sub-Saharan Africa (TESSA), a non-governmental organization, researched and developed high quality resources and support systems in ways that can help significantly to improve teacher education. Phase 1 of the TESSA programme is aimed at improving classroom practices in basic education with a particular focus on literacy, numeracy, science, life-skills, social studies and the arts (TESSA, 2009). Another organization in the country concerned with this is Community Participation for Action in the Social Sector (COMPASS), a project lunched by the Federal Government of Nigeria and United State Agency for International Development (USAID) in the year 2004. The project aims at improving the health and education status of 23 million Nigerian children who reside in COMPASS states (Lagos, Kano, Nasarawa, Bauchi and FCT). One of their focuses is effective education which is only achievable through the training of teachers in teaching methodologies that are girl child-friendly and encourages students' participation (COMPASS, 2009). All these interventions are either introduced in selected parts of the country or as workshops for in-service teachers where no effort was made to train the teachers on how to plan the lesson for the new strategy introduced. While Omosehin's (2004) study focused on training teachers on the knowledge and attitude towards the use of CL, it was silent about the lesson plan for the strategy to be used. The possible result of these efforts is that the teachers are well knowledgeable about various strategies but are still novices regarding how to plan for such strategies. Having the knowledge of Activity-Based Instructional Strategy is one thing; ability to plan, use and evaluate it is another.

Lesson planning skills, according to Arends (2004), Parkey and Stanford (2004) and Kizlik (2010), are necessary skills all teachers must acquire, in order to have a successful and effective teaching. Hence, there is the need to focus on how to develop the lesson planning skills as well as lesson delivery skills of activity-based instructions in teacher training institutions so as to make the teachers more effective, especially those teaching an abstract subject like Mathematics, which students dread and fail.

The lesson plan currently being used in the University of Ibadan as indicated in the Professional Practice Record Book, has the following in common:

a) General information about the class and subject.
b) Expected outcomes in terms of pupils behaviour and needed materials
c) Teacher's presentation (which is, most of the time, teacher's activities on 'how to do it')
d) Evaluation (class exercises which are always do-it-like-our-teacher-did-it)

Any lesson delivered using this format is most likely to be teacher-centred, chalk-and-talk method which does not encourage pupils' active involvement. This type of teaching method has not been found to be effective in teaching Mathematics (Akinsola, 1994; Oladeji, 1997; Akinsola, 2002; Awofala, 2002; Amobi, 2003; Olosunde, 2009).

In some developed countries where effective teaching is emphasised in the school system, different teaching strategies, with different lesson plan formats that could enhance the implementation of such strategies, are developed. That is why there are various lesson plan formats for activity-based instructional strategies. For instance, Engel (2002), while using learner-centred activity-based strategy on statistics students in a college in Germany, used a four part model. The parts include: (1) Introduction of a "real-world" problem involving some aspects of data analysis (2) Doing an activity related to understanding the dynamics of the problem (3) Representing the simulation model with a computer-based random number generator and (4) Mathematical analysis based on probability and mathematical statistics.

High/Scope pre-school programme in the USA sees active participatory learning model as a 5-part model. The parts include: (1) Materials: The programme offers abundant supplies of diverse, age-appropriate materials. These materials are the ones that can appeal to all the senses and they are open ended. (2) Manipulation: children are allowed to handle, examine, combine, and transform materials and ideas. They make discoveries through direct hands-on and minds-on contact with these materials. (3) Choice: children choose materials and play partners, change and build on their play ideas and plan activities according to their interest and needs. (4) Child language and thought: children are allowed to describe what they are doing and their understanding. They are allowed to communicate verbally and non-verbally as they think about their actions and modify their thinking to take new learning into account. Since discussing Mathematics implies understanding Mathematics, and (5) Adult scaffolding: to High/Scope programme, scaffolding means adult support children's current level of thinking and challenges them to advance to the next stage (Epstein, 2007).

In Nipissing University, Ontario Canada, a format was designed for planning activity lesson in which the key stages are: Expectation(s) and learning skills: here the learning outcomes or the objectives of the lesson are clearly stated. Pre-assessment: under pre-assessment stage, the assessment of the learner, learning environment, availability/improvisation of resources are stated. Content: this stage is meant to spell out the "what" of the lesson, that is, what is to be delivered in order to achieve the predetermined expectations. Teaching/learning strategy: here, both the pupils and the teachers activities tailored towards the content as well as the expectations are identified. Assessment: the assessment tools, procedure, collection of data and evaluation are stated and student's/teacher's reflections on the lesson: this stage is divided into two parts. Part A deals with evidence of student learning and next steps for student learning while part B deals with evidence of the effectiveness of the teaching and next steps.

It is worth emphasising that in these three lesson plan formats, the pupils' activities are central to the lesson. There is a distinct difference between these types of lesson plans and the one commonly used in Nigerian Teacher Programmes as discussed earlier. For instance, Activity Lesson Plan Format developed in Nipissing University, Ontario Canada, has other features, such as: Pre-assessment of classroom environment and available resources and materials; Pupils' activities as well as expected teachers' roles and Pupils' and teacher's reflections on the lesson. These additional features make the lesson pupils-centred where the teachers act as guide and facilitators of learning. This study adapted the Nipissing University Activity Lesson Format to create a model that could work in this context. This model is preferred because it takes into consideration measurement of the entry behaviour of the pupils and setting the behavioural objectives. It also considers selection and manipulation of materials, understanding the mathematical concepts embedded in the activities and giving room for scaffolding from a more experienced facilitator (a lecturer or a teacher as the case may be).

There are usually many things to be done in an activity oriented mathematics lesson: the corrections of the previous home-work; presentation of the new idea; pupils' or teacher's hands-on activities; guiding and correcting the pupils' activities before finally evaluating the whole lesson. All these have to take place within the 35 minutes lesson duration. It is only a skilful, well-trained and experienced teacher that could deliver activity oriented primary mathematics lesson interestingly and successfully (Eggen and Kauchak, 2006). This implies that pre-service teachers must have been planning and delivering activity-based and/or demonstration lessons while on training for them to do so when they are out of the college. But an examination of the training in the colleges of education in Nigeria reveals that this is not so (Aleburu, 2008; Salami, 2009; Chukwu, 2009; Olosunde, 2009).

For a mathematics teacher to deliver any strategy (or method) effectively, some other important factors may come into play. Some of these factors include the numerical ability; perception of the teacher about the strategy to be used; gender of the teacher and the attitude of such teacher towards teaching. For instance, the Commissioner of Education in Kwara State of Nigeria revealed something about the quality (as related to the knowledge of the subject matter) of public primary school teachers in the state. 19,125 of them were given a test meant for primary IV pupils and only 7 (0.04%) scored above the minimum aptitude and capacity threshold (The Guardian, December. 14th 2008). One of the most important reasons for this dismal performance, according to the writer, is that teacher education has also failed them. This implies that the teaching-learning methods the teachers were exposed to during their training has failed to equip them with the in-depth understanding of the topics in primary Mathematics, and since it is impossible to give what you do not have, it is impossible, then, for these teachers to teach primary Mathematics effectively. That is why it is considered that a good understanding of Mathematics is important for the primary mathematics teachers.

Besides this, the perception of a teacher about instructional strategies could dictate which of the strategies the teacher will eventually use. It has been established that the perception of a teacher about any instructional strategy influences the extent to which such teacher will like to use the strategy; improve his/her skill on how to use the strategy and the confidence on the use of the strategy (Kemp, 2003). Therefore, it is imperative to observe the perception of pre-service teachers about every new strategy exposed to them. This can reveals the extent to which such teachers will use the new strategy.

For a teacher to be able to deliver various methods in teaching a given subject, s/he must have adequate knowledge of the subject matter. The National Board for Professional Teaching Standard (NBPT, 2001) as quoted by James, Raths and Roy (2005) and Eggen and Kauchak (2006) shows that knowledge of subject matter, which is also known as numerical ability in this study, is an important prerequisite for effective teaching. Kennedy (1997) also supports this fact. In this respect, students of primary mathematics in the colleges of education are made to take primary mathematics contents courses in PES 113, 122, 222 and 324 so as to gain in-depth knowledge of the subject (NCCE, 2009). Therefore, numerical ability of pre-service primary mathematics teachers is considered important and was examined as a moderator variable in this study.

Another important factor that could affect mathematics teaching that was examined in this study is pre-service teachers' gender. The discussion of gender and Mathematics and science learning is far from being concluded. Between 1970 and 1990, there were more educational research studies on Mathematics and gender than any other area (Fennema, 2000). Scholars are still grappling with the issue in order to determine whether the causal relationship between mathematics teaching-learning and the gender factor is biologically related or it is socially or environmentally related. If the inability of female to achieve as high as their male counterparts, as revealed by researches (Fennema and Sherman, 1977, 1978; Fennema, 2000; Halpern, 2000; Casey, Nuttall and Pezaris, 2001; David, 2003; Becker, 2003; Gilbert and Gilbert, 2003; James 2007), is biologically related, there is little or nothing that can be done to correct it. But on the other hand, if it is socially or environmentally related, then it can be corrected. This is supported by some research findings that show that the gap between male and female students' performance in Mathematics is disappearing (Spencer, Steel and Quinn, 1999; Austin, 2002; Berube and Glanz, 2008). The argument here is that, if female students have low performance in Mathematics, there would be less number of female pre-service primary mathematics teachers and the few that exist would have little knowledge of the subject matter. This eventually would affect their teaching. It should not be inappropriate, then, to examine the moderating effect of gender on this study that emphasizes the teaching process.

1.2 Statement of the Problem

The incessant poor performance of pupils in primary Mathematics has been attributed to the adoption of teacher-centred method of teaching by the teachers. This method of teaching is characterized by listening, note-taking and, at times, working some mathematical exercises following the teacher's algorithm. The adoption of activity-based strategies has been advocated as the way out of this problem. The lack of skills by primary mathematics teachers to deliver an activity-based lesson has been traced to the fact that they were not trained for this. Besides this, these trainees were not taught through activity-based strategies while in colleges.

Many organizations, individuals and the federal government have noticed this shortcoming in the teacher education programmes in Nigeria and have been initiating various interventions. Various instructional strategies such as Cooperative Learning, Group Discussion and Activity-Based were exposed to primary school teachers either in workshops or in selected colleges of education. But none of these interventions included the training of these teachers on how to plan the lesson for the new strategy introduced.

Therefore, it is against this background that this study determined the effects of training programmes in activity-based and demonstration strategies on pre-service primary mathematics teachers' acquisition of activity-based lesson planning and delivery skills. The effects of pre-service teachers' numerical ability as well as their gender on the acquisition of activity-based lesson planning and delivery skills were also examined.

1.3 Research Questions

The following questions will be used as guide to this study

1) What is the perception of the pre-service teachers exposed to training programmes about pupil-centred activity-based and teacher demonstration activity-based strategies?
2) What part of lesson planning for activity-based strategies do the pre-service teachers exposed to the training find difficult?
3) What are the difficulties faced by the pre-service teachers exposed to activity-based strategies in the process of using it to teach primary Mathematics?

4) To what extent does the treatment influence the pre-service primary mathematics teacher's academic performance in PES 122 (Mathematics in Primary Education Studies II)?

1.4 Hypotheses

Ho1: There is no significant main effect of treatment on pre-service teachers' lesson planning skills.

Ho2: There is no significant main effect of numerical ability on pre-service teachers' lesson planning skills

Ho3: There is no significant main effect of gender on pre-service teachers' lesson planning skills.

Ho4: There is no significant interaction effect of treatment and numerical ability on pre-service teachers' lesson planning skills.

Ho5: There is no significant interaction effect of treatment and gender on pre-service teachers' lesson planning skills.

Ho6: There is no significant interaction effect of numerical ability and gender on pre-service teachers' lesson planning skills.

Ho7: There is no significant interaction effect of treatment, numerical ability and gender on pre-service teachers' activity-based lesson planning skills.

Ho8: There is no significant difference among pre-service teachers exposed to TDS, PABIS and Conventional strategies in their activity-based mathematics lesson delivery after the training.

Ho9: There is no significant difference among pre-service teachers with low, average and high numerical ability in their activity-based mathematics lesson delivery after training.

Ho10: There is no significant difference between male and female pre-service teachers in their activity-based mathematics lesson delivery after training.

Ho11: There is no significant difference among pre-service teachers in their academic performance in PES 122.

1.5 Scope of the Study

This study focused on the acquisition of skills of planning and utilization of activity-based lessons (that is, selection of behavioural objectives, selection of materials, identifying pupils and teachers' activities and evaluating the lesson) by pre-service primary school mathematics teachers in colleges of education in southwest states of Nigeria. Two forms of activity-based instructional strategies were used to expose the pre-service teachers to the skills of planning and utilization of activity-based lessons. These are: Pupils-centred Activity-based Instructional Strategy and Teacher Demonstration Activity-based. The study adapted the activity-based lesson plan format developed by NIPISSING University, Ontario, Canada (2008) to train the pre-service teachers. The adapted activity-based lesson plan format covers the following sub-headings: General Information, Pre-assessment, Behavioural Objectives, Classroom Activities, Assessment and Teacher's Reflection on the Lesson. The effects of numerical ability and the gender of the pre-service teachers on their planning and utilization of activity-based lessons were also examined.

1.6 Significance of the Study

This study is considered significant because it serves as empirical background to support a change in the current way the primary school mathematics teachers are trained. The practice of teaching mathematics methodology courses in the Colleges of Education through teacher-centred methods should be revisited and the method of learn-to-do-it-by-doing-it (Activity-based Instructional Strategy) should be considered. This study has created the basis and justification for the change in the teacher preparation in the colleges of education.

The activity-based strategy, has found effective in this context, would be a way of relieving teachers of having to carry out all the teaching activities- talking, demonstrating and writing. Teaching and learning process is expected to become exciting to the teachers and they should have the wherewithal to lead their pupils to discover new ideas, algorithm and mathematical facts in their classes.

The indirect benefit, which is the major rationale behind the whole study, is the improvement of pupils' performance in Mathematics. This can only happen if there is effective teaching in the primary school system. This study has led the way towards developing not only better performance in primary Mathematics but also effective learning of the subject which will facilitate the learning of sciences and Mathematics in further education and ability to solve their daily problems that require mathematical skills.

It is also envisaged that the effectiveness of this strategy, as revealed by this study, will be published widely. If well adopted in Nigerian educational system, the society will also benefit from it. For instance, more students would feel encouraged to study mathematics related courses (sciences, technology and mathematics) in Nigeria higher institutions and more effective and functional discoveries that are related to the Nigeria situation (economy, environment, social and cultural) will be experienced in the country. Also, this investigator has now discovered a life-long goal of preparing pre-service teachers, lecturers teaching primary Mathematics in the Colleges of Education as well as Faculties of Education in the Universities and in-service teachers for planning and implementing an activity-based lesson on primary Mathematics. This is the only way this strategy could be widely spread all over the primary schools in the country.

1.7 Operational Definition of Terms

The following terms are hereby defined as used in this study:

Activity-based lesson: This is a primary mathematics lesson in which the pupils are allowed to carry out some pre-determined hands-on activities or observe someone carrying out the activities that are capable of exposing the pupils to the understanding of the mathematical concept to be delivered.

Activity-based strategy: This is a teaching strategy that gives learners an opportunity to learn new concept, and acquire knowledge and skills through manipulative of materials or exploration of real-life situation. This could be in two forms, namely, pupil-centred activity based or teacher demonstration. Learners are allowed to learn how to do things by doing them.

Demonstration strategy: As used in this study, this is a type of activity-based teaching strategy wherein the teacher actually demonstrates the activities that could lead to better learning of the subject/topic at hand by manipulating materials.

Impact: Impact of treatment in this study is the effect of the treatment on the lesson planning, lesson delivery, attitude and academic performance of the pre-service teachers in primary Mathematics.

Lesson planning skills: These are the skills necessary for the planning and writing of a good lesson plan for primary Mathematics. The major ones examined in this study include:

a) Setting behavioural objectives based on the content
b) Selection of materials
c) Identifying both pupils' and teacher's activities
d) Identifying tools and items to assess the pupils' learning.

Lesson delivery skills: These are the skills necessary for the lesson presentation. In this study, they include introduction, provision of materials (using the materials either by the teacher or the pupils) and ability to evaluate the whole mathematics lesson.

Numerical ability: In this study**,** it is the average performance of the pre-service teachers in the numeric test that will be administered. This numerical test is designed based on primary mathematics contents.

Pre-service primary mathematics teacher: This is defined as a student undergoing training in a college of education to become a teacher of primary Mathematics.

Pre-service teachers' gender: This is the classification of the pre-service teachers into either male or female. This is to be able to measure those biological, social and/or environmental factors that could be classified into masculine or feminine, and that could affect pre-service teachers in the teaching of primary Mathematics.

Pupil-centred activity-based strategy: This is another type of activity-based instructional strategy in which learners manipulate materials or explore real-life situation in order to gain better understanding of the mathematical concept.

Teachers' attitude: This is taken to mean the dispositions of the pre-service teachers towards teaching as a profession.

Teaching: This refers to a human teacher led instructional dissemination, especially in a classroom setting.

CHAPTER TWO

LITERATURE REVIEW

Relevant literature will be reviewed under the following sub-headings:

2.1. **Theoretical Background**

2.1.1 Experiential Learning Theory

2.1.2 Activity Theory

2.2. **Review of Related Literature**

2.2.1 Teaching as a means of knowledge acquisition;

2.2.2 Teacher Education and preparation of teachers for Primary Education;

2.2.3 Methods of teaching primary Mathematics courses in tertiary institutions generally and Colleges of Education in particular in Nigeria;

2.2.4 Pupil-centred Activity-based, Teacher Demonstration and other instructional strategies and planning and delivery primary Mathematics and primary mathematics methodology courses in teacher training programmes;

2.2.5 Numerical ability of primary mathematics teachers as related to their Teaching practices.

2.2.6 Teachers' Gender and mathematics teaching practices and learning.

2.2.7 Appraisal of literature Review.

2.1. Theoretical Background

This study is anchored on two educational theories. The first is known as Experiential Learning Theory propounded by David Kolb (1984) and the second is Activity Theory which was propounded by Vygotsky, Leont'ev and Luria in the early 20th century (Engestrom 1999).

2.1.1 Experiential Learning Theory

Experiential Learning Theory states that learning is the process whereby knowledge is created through the transformation of experience. The theory presents a cyclical model of learning, comprising four stages shown below:

- concrete experience (or "DO")

- reflective observation (or "OBSERVE")
- abstract conceptualization (or "THINK")
- active experimentation (or "PLAN")

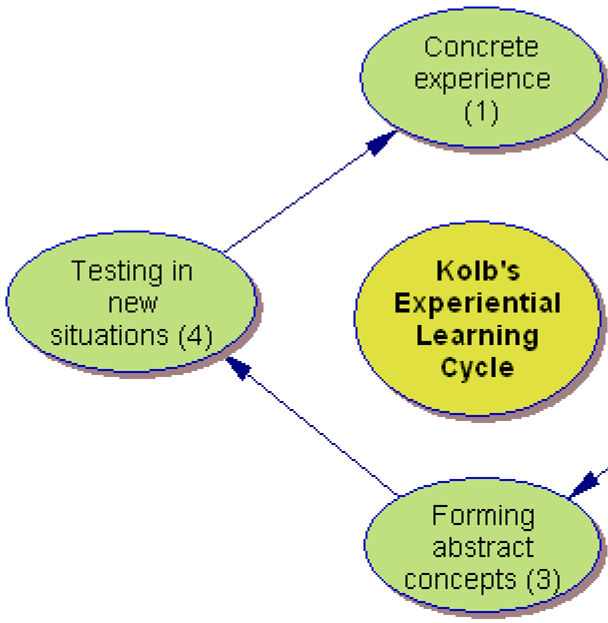


Figure 2.1: *Kolb's Experiential Learning Cycle* (1984).
Source: Learning theories.com: Knowledge base and webliography

Kolb's four-stage learning cycle shows how experience is translated, through reflection, into concepts, which in turn are used as guides for active experimentation and the choice of new experiences. The first stage, *concrete experience* (CE), is where the learner actively experiences an activity such as a laboratory session, field work or is involved in activities in the classroom. The second stage, *reflective observation* (RO), is when the learner consciously reflects on that experience. The third stage, *abstract conceptualization* (AC), is where the learner attempts to conceptualize a theory or model of what is observed. The fourth stage, *active experimentation* (AE), is where the learner is trying to plan how to test a model or theory or plan for a forthcoming experience.

Kolb identified four learning styles which correspond to these stages. The styles highlight conditions under which learners learn better. These styles are:

- assimilators, who learn better when presented with sound logical theories to consider

- convergers, who learn better when provided with practical applications of concepts and theories
- accommodators, who learn better when provided with "hands-on" experiences
- divergers, who learn better when allowed to observe and collect a wide range of information.

This study draws from this experiential learning theory as it has to do with pre-service teachers who would be involved in active learning process (termed 'do' by Kolb); observing the relationships and results in the content being learnt ('observe'); reflecting on the relationships and results ('think') and planning any given mathematics lesson using this method ('active experimentation'). The activity-based learning strategies (Learner-based Activities and Teacher Demonstration) promote three out of the four learning styles identified in Kolb's experiential theory, that is, the convergers, the accommodators and the divergers. The styles highlight conditions under which learners learn better. These styles are:

- assimilators, who learn better when presented with sound logical theories to consider
- convergers, who learn better when provided with practical applications of concepts and theories
- accommodators, who learn better when provided with "hands-on" experiences
- divergers, who learn better when allowed to observe and collect a wide range of information

In other words, pre-service teachers that prefer learning through practical experience, learning through hands-on experience or observation and collection of a wide range of information would perform at their maximum capability in activity-based strategies. Such teachers would be able to plan, present and evaluate activity-based lesson for primary school pupils during practicing.

2.1.2 Activity Theory

Activity theory was propounded by Vygotsky, Leont'ev, Luria, and some German philosophers (from Kant to Hegel) in the early 20th century (Engestrom, 1999). Activity theory was updated recently by Yrjo Engestrom and it states that the unit of analysis (of learning) is motivated activity directed at an object (goal) which includes cultural and technical mediation of human activity, and artifacts in use (and not in isolation). It is more of a descriptive meta-theory or framework than a predictive theory. It considers entire work/activity system (including teams, organizations, etc.) beyond just one actor or user. It also accounts for environment, history of the person, culture, role of the artifact, motivations, complexity of real life action and so on.

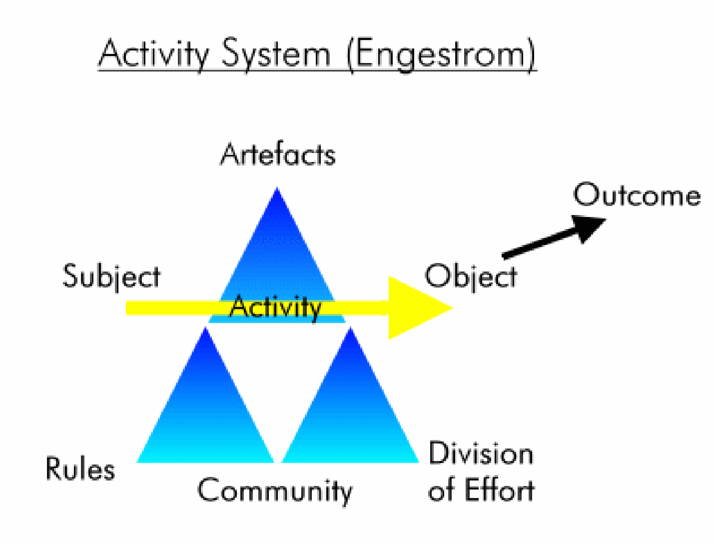


Fig. 2.2 Activity System Chart (1999).
Source: Learning theories.com: Knowledge base and webliography

Engestrom's model as shown above is useful for understanding how a wide range of factors work together to impact an activity. In order to reach an *outcome* it is necessary to produce certain *objects* (things to use e.g. experiences, knowledge, and physical products). Human activity is mediated by artifacts (e.g. tools used, documents, recipes, manipulative etc). Activity is also mediated by an organization or community. In addition, the community may impose rules that affect activity. The subject works as part of the community to achieve the objectives. An activity normally also features a division of labour.

Three levels of activity suggested by this theory include:

- Activity towards an objective (goal) carried out by a community. A result of a motive (need) that may not be conscious social and personal meaning of activity (Answers the Why? question)
- Action towards a specific goal (conscious), carried out by an individual or a group possible goals and subgoals, critical goals (Answers the What? question)
- Operation structure of activity typically automated and not conscious concrete way of executing an action in accordance with the specific conditions surrounding the goal (Answers the How? question)

Based on this theory, this study considers activity-based strategy as a process of blending together of materials, the learners, the classroom situation, rules and regulations guiding the activities and the networking among the learners and the teacher in order to achieve the pre-determined behavioural objectives. In other words, the pre-service teachers' understanding of how to plan, present and evaluate an ABL is achievable in a situation where materials are presented for them to work on under the guidance of the lecturer in a classroom situation. The success or otherwise of individual learning is measured by the attainment of the objectives (ability to select appropriate material, plan, present and evaluate an ABL).

2.2 Review of Related Literature

2.2.1 Teaching as a Means of Knowledge Acquisition

Right from the beginning of time, there have been many ways by which man came about knowing. Knowledge could come through discovery, intuition, revelation, information (instruction) and so on. Of all these, the fastest, most effective and best recognised medium is the knowledge through instruction (or teaching). This is not unconnected to the fact that it is recognised to be an act from a well informed person (teacher) to less informed person (student). The well informed person is seen as a cultured, intelligent, well-behaved, respected and capable of integrating the younger ones into the society, hence teachers are not expected to be ignorant of how to teach effectively (Cruickshank, Jenkins and Metcalf, 2003; Moronkola, 2011).

Initially, literate individuals, often young men studying for the ministries, were hired on a part-time basis (or literate slaves) to tutor or teach the children of the more wealthy families and when schools started to emerge in the eighteenth century, the teachers selected by the local communities did not have any special training (Arends, 2004). This could have been partly responsible for the status of teachers as slaves and the engagement of untrained individuals in the teaching profession in Nigeria particularly, until recently when the Federal Government instructed them to get trained or get out of the profession (FGN, 2004). The reason for this development is as a result of the fact that the responsibilities expected of teachers now are not what non-professionals could handle.

Up to the nineteenth century, the primary goal of education (which happened to be the expected roles of teachers) is the basic literacy and numeracy skills which was termed ‘the three Rs’ (reading ‘riting and ‘rithmetic) (Arends, 2004). The training of teachers at this time was also theoretical based. An enormous amount of psychological, sociological, and educational researches were carried out, offering us a body of knowledge that in principle can be very useful to the teaching practices.

In teacher education, the desire to use as much of the available knowledge as possible has led to a conception of teacher education as a system in which experts, preferably working within universities, teach this knowledge to prospective teachers. In the best case, they also try to stimulate the transfer of this knowledge to the classroom, for example, by the use of assignments to be carried out during field experiences. This is how teacher education became known as "teacher training" (Bullough and Gitlin, 1994). Schon (1987) called it the "technical-rationality model." Many teacher programmes consist of a collection of separated courses in which theory is presented without much connection to practice (Korthagen and Kessels, 1999). In many places in the world the tendency to focus on knowledge bases to be taught to prospective teachers became even stronger. This emphasis on expert-knowledge dominant for many decades, did not change, although many studies show its failure to strongly influence the practices of graduates of teacher education programmes (Korthagen and Kessels, 1999). Zeichner and Tabachnick (1981), for example, showed that many notions and educational conceptions, developed during teacher education, were "washed out" during field experiences. Lortie (1975) presented us with another early study into the socialization process of teachers, showing the dominant role of practice in shaping teacher development. At Konstanz University in Germany, large-scale researches were carried out into the phenomenon of the "transition shock" (Muller-Fohrbrodt, Cloetta, and Dann, 1978; Dann, Cloetta, Muller-Fohrbrodt, and Helmreich, 1978; Dann, Muller-Fohrbrodt, and Cloetta, 1981; Hinsch, 1979), which regrettably went largely unnoticed by the English-speaking research communities. It showed that teachers pass through a quite distinct attitude shift during their first year of teaching, in general creating an adjustment to current practices in the schools, and not to recent scientific insights into learning and teaching.

Brouwer (1989) did an extensive quantitative and qualitative study in the Netherlands, also showing the dominant influence of the school on teacher development. He found that an important factor promoting transfer from teacher education to practice was the extent to which the teacher education curriculum had an integrative design, that is, the degree to which there was an alternation and integration of theory and practice within the programme.

Some of the causes of the transfer problem in teacher education have also been well documented. Using a cognitive-psychological perspective, one of the three major causes identified is the learning process within the teacher education institute itself (Korthagen and Kessels, 1999). Stofflett and Stoddart (1994), for example, argue that teachers' conceptions of teaching subject matter are strongly influenced by the way in which they themselves learnt this subject content. They have shown that student teachers who themselves experienced learning in an active way are more inclined to plan lessons that facilitate students' active knowledge construction. Akinbote (1999), Cruickshank; Jenkins and Metcalf (2003), and Khazanov (2007) also support this argument. Huibregtse, Korthagen, and Wubbels (1994) showed that even with experienced teachers, there is a strong relationship between their preferred way of teaching and the way they themselves are used to learning: they have a limited view of the learning styles of their students and tend to project their own way of learning onto the learning of their students. In sum, Corporaal (1988) interprets the poor transfer of theory to practice as a lack of integration of the theories presented in teacher education (the teacher educator's theory) into the conceptions student teachers bring to the teacher education programme (the student teachers' theory).

Although the transfer problem in teacher education is well-known and its causes have been thoroughly researched, it is remarkable that many teacher education programmes still reflect the traditional "application-of-theory model" described above (Korthagen and Russell, 1995), although it is hard to derive reliable conclusions about this from the literature. Zeichner (1987) once noted that very little is published about concrete strategies and programme arrangements. In the work of Korthagen and Kessels (1994), based on trainers of teacher educators in various countries, it is reported that everyday pedagogy of teacher education was given that the traditional view of teacher education has basically not changed and even that many "new" approaches often take the form of sophisticated procedures to try and interest student teachers in a particular theory, or bridge the gap between the theory presented and teaching practice. This means that the traditional approach, in which teacher educators make an *a priori choice* about the theory that should be transferred to student teachers, represents a very dominant line of thought. The fundamental conception inherent in this line of thought is that there is a gap to be bridged. One often forgets that it was the *a priori choice* that created this gap in the first place. Of course, the conditions under which teacher education takes place are generally not very supportive of a change in old habits: large enrolments and limited time for teacher educators to visit student teachers during their teaching practice are inhibiting factors (Barone et al., 1996, p. 1117).

But by late nineteenth and early twentieth centuries, the purposes of education were expanding rapidly and consequently teacher's roles took on added dimensions. On account of this, every society has been expecting more from teachers than before. In several places throughout the world, teacher education faces a lot of challenges. The pressure towards more school-based programmes, which is visible in many countries, is a sign that not only teachers, but also parents and politicians, are often dissatisfied with teacher education (Ashton, 1996; Korthagen and Kessels, 1999). In Great Britain, for example, a major part of pre-service teacher education became the responsibility of the schools, creating a situation in which, to a large degree, teacher education takes the form of "training on the job." The argument in support of this tendency was that traditional teacher education programmes are said to fail in preparing prospective teachers for the realities of the classroom (Goodlad, 1990).

As a reaction to weaknesses of the traditional approach to teacher education, some innovative educators have developed new ways of preparing teachers for their profession. Many of these attempts have been characterized by an emphasis on reflective teaching (Calderhead, 1989; Moronkola, 2011). This implies that teacher development is conceptualized as an ongoing process of experiencing practical teaching and learning situations, reflecting on them under the guidance of an expert, and developing one's own insights into teaching through the interaction between personal reflection and theoretical notions offered by the expert.

In many teacher education programmes this alternative view is currently being worked out. Impressive steps were made towards the construction of a theoretical basis for such an approach, for example, by formulating the cognitive psychological underpinnings, mostly in terms of constructivism (Korthagen and Kessels, 1999), or sociological considerations, generally in terms of goals to strive for and methods to reach these goals (Zeichner, 1983; Liston and Zeichner, 1990), and the ethical dimensions involved. Research into strategies and effects has also been published (Zeichner, 1987; Zeichner and Liston, 1987; Gore and Zeichner, 1991). To this end, Markusic (2009) suggests learner-centred method of teaching in which he argues that, since students are nowadays no longer viewed as “tabula rasa,” teaching philosophy should be learner-centred.

Although the large number of influential publications in this area is still growing, there are two respects in which the theoretical basis underlying this approach remains weak. First, compared to the traditional theory as found in academic textbooks, "theory" takes on a completely different form in a programme aiming at the integration of theory and practice. The nature of these different kinds of theory has not yet been thoroughly studied (Korthagen and Kessels, 1999). Consequently, the characteristics of effective types of knowledge, with possible indications about what to offer when and to which student teacher, are as yet ongoing. In order to develop such a theory on the use of theory in teacher education, a second theoretical basis for teacher education is needed, concerning the relationship between teacher cognition and teacher behaviour. Recent insights into this relationship contradict the classical view of the teacher as a theory-guided decision-maker, but a new, comprehensive theory on teacher thinking and teacher behaviour has yet to take the place of the old. Several notions, which are in fact remnants of an outdated view, still survive, such as the concepts of "declarative and procedural knowledge" or terms like "misconceptions" of teachers. The variety of different notions and assumptions underlying new approaches have not yet created a sound basis for further development.

Over the years, teacher educators have been introducing instructional innovation. In1996, an entire issue of *Teacher Education Quarterly* was devoted to innovative colleges of education (Malian and Navin (2005). Other researchers have studied team teaching in teacher education (Cruz and Zaragosa,1998); teacher educators’ beliefs about professional development schools (Malian and Navin (2005); alternative teacher education programmes such as school-university partnerships (Benton, 1996). However, Melvin (1993) calls for more concerted efforts to study the influence of professional studies by faculties of education on actual practice in classrooms and schools. Burkhardt and Schoenfeld (2003) raised another concern that emphasized the notion that research could be more useful if its structure and organization were better linked to the practical needs of the educational system.

The recognition given to education in general could be attributed to effective teaching. That is why it is not inappropriate to say that educational system cannot rise above the quality of its teachers (FGN, 2004). As good as teaching seems to be, it should be noted that teaching may fail to produce any expected result (Parkay and Stanford, 2004) and effective teaching in developmental education is one of the most challenging jobs in the college teaching profession (Smittle, 2003). One may teach while the learner may fail to learn as expected in the content taught. This, in other words, tells us that teaching could be either effective or ineffective. A situation whereby teaching brings about the achievement of the predetermined objectives, such is said to be effective but if otherwise, ineffective (Anderson, 2004).

Eberly Centre for Teaching Excellence (2010) suggests seven small but powerful set of principles that can make teaching more effective and more efficient by creating the conditions that support students' learning and minimize the need for revising materials, content, and policies. Four out of these seven points explain the concept of effective teaching from the angle of the argument presented in this study. These are:

1. **Effective teaching involves acquiring relevant knowledge about students and using that knowledge to inform our course design and classroom teaching.** When we teach, we do not just teach the content, we teach students the content. A variety of student characteristics can affect learning. For example, students' cultural and generational backgrounds influence how they see the world; disciplinary backgrounds lead students to approach problems in different ways; and students' prior knowledge (both accurate and inaccurate aspects) shapes new learning. Although we cannot adequately measure all of these characteristics and gathering the most relevant information as early as possible in course planning, we continue to do so during the semester. This, (a) inform course design (decisions about objectives, pacing, examples, format), (b) help explain student difficulties (identification of common misconceptions), and (c) guide instructional adaptations (recognition of the need for additional practice).

2. **Effective teaching involves aligning the three major components of instruction: learning objectives, assessments, and instructional activities.** Taking the time to do this upfront saves time in the end and leads to a better course. Teaching is more effective and

student learning is enhanced when (a) we, as instructors, articulate a clear set of learning objectives (the knowledge and skills that we expect students to demonstrate by the end of a course); (b) the instructional activities (case studies, labs, discussions, readings) support these learning objectives by providing goal-oriented practice; and (c) the assessments (tests, papers, problem sets, performances) provide opportunities for students to demonstrate and practice the knowledge and skills articulated in the objectives, and for instructors to offer targeted feedback that can guide further learning.

3. **Effective teaching involves recognizing and overcoming our expert blind spots.** We are not our students! As experts, we tend to access and apply knowledge automatically and unconsciously (make connections, draw on relevant bodies of knowledge, and choose appropriate strategies) and so we often skip or combine critical steps when we teach. Students, on the other hand, don't yet have sufficient background and experience to make these leaps and can become confused, draw incorrect conclusions, or fail to develop important skills. They need instructors to break tasks into component steps, explain connections explicitly, and model processes in detail. Though it is difficult for experts to do this, we need to identify and explicitly communicate to students the knowledge and skills we take for granted, so that students can see expert thinking in action and practice applying it themselves.

4. **Effective teaching involves adopting appropriate teaching roles to support our learning goals.** Even though students are ultimately responsible for their own learning, the roles we assume as instructors are critical in guiding students' thinking and behaviour. We can take on a variety of roles in our teaching (synthesizer, moderator, challenger, commentator). These roles should be chosen in service of the learning objectives and in support of the instructional activities. For example, if the objective is for students to be able to analyze arguments from a case or written text, the most productive instructor role might be to frame, guide and moderate a discussion. If the objective is to help students learn to defend their positions or creative choices as they present their work, our role might be to challenge them to explain their decisions and consider alternative perspectives. Such roles may be constant or variable across the semester depending on the learning objectives.

Smittle (2003) also believes that addressing non-cognitive issues affecting learning is one of the principles that bring about effective teaching. Smittle argues that adults in education programmes often carry many non-academic problems with them when they enrol in college. Therefore, the successful developmental education teacher must develop the whole student rather than solely deal with cognitive skill deficits. Toch (2010) submits the findings of National Survey of Student Engagement (NSSE) that focused on teaching practices and out-of-class qualities that research has found to correlate with learning of pre-service teachers in United States-such things as the number of books and lengthy papers assigned in courses, how much coursework involves applying theories to practical problems, how much homework teachers assign, and how often they discuss coursework outside of class with teachers and classmates. Since its founding, NSSE has gathered information from over 3 million students in the United States and Canada and spawned a similar survey of community college students. The organization says it has found little relationship between having a prominent brand name and teaching students well.

Teachers indicate that motivating students to learn and to participate in learning activities may be the most difficult task, especially in working with student teachers. Related affective characteristics, such as self-regulation and academic procrastination, can be influenced by motivation. Kachgal, Hansen, and Nutter (2001) have reported that procrastination "compromises an individual's ability to set and achieve personal, academic, and career related goals" through self-regulated behaviour. Further, Wambach et al. (2000) state that students who can self-identify skill areas that need improvement and are motivated to pursue assistance to gain appropriate skills are self-regulated. Quoting Wambach,

> "The conscious development of self-regulation is the task that might distinguish developmental education programs from other postsecondary education programs" (p. 3).

Some teachers, especially those with graduate school mentalities, declare that it is not their responsibility to motivate students. These teachers need to engage in professional development quickly. It is, indeed, the responsibility of developmental education and all education to help students sustain the motivation that led them to enrol in courses at the beginning of the semester and strengthen that motivation as the term progresses. Teachers are challenged to try to determine how and when students lost their motivation and help them regain that initial vision. Of course, motivation is a team effort: no teacher can motivate a student who does not want to join the effort.

McCombs (1991) and the *Stanford University Newsletter on Teaching* ("Speaking of,"

1998) recommend these strategies for motivating students: define course goals and help students think about personal learning goals, make use of students' interests and background knowledge, show the relevance of material, teach students skills for independent learning, and give helpful and frequent feedback.

Helping students set goals is critical to maintaining motivation. Unfortunately, many teachers assume that adults in college have well-defined goals for their lives and they should recognize that the developmental courses are the first step toward achieving those goals. It is the responsibility of the teacher to help students set both short- and long-term goals. At this point professional teamwork is vital, and the teacher may need to call on the advisors to help. Goal setting may well be the factor that determines if the student will complete the developmental course and continue in school long enough to achieve those goals. Tinto (1993) reported that students who have clear goals are more likely to be retained. An effective developmental education teacher helps each student create a vision and see how the course and everyday activities help to achieve that goal, a first step that should be repeated throughout the student's academic career.

Developing and maintaining positive self-esteem is important for developmental students. Although some of them don't show it, they often have low self-esteem, especially in regard to academic work. Teachers can help students overcome those perceptions that impede learning by using suggestions from research: create a supportive environment among students, enhance self-esteem through comments such as "you're on the right track...," simplify objectives and learning, use success in learning to promote student satisfaction, demand specificity in learning, advise and coach frequently, and avoid excessive negative feedback (Presiosi, 1990).

For teaching to be effective, the teacher must not only have the knowledge of the goal and what to teach (subject matter) but how to teach effectively (pedagogical skills). While discussing how the knowledge of the objective (or goal) could affect teaching, Cruickshank, Jenkins and Metcalf (2003) submit that the nature of the objectives determines how to teach. Therefore, the knowledge as well as in-depth understanding of the goals of what to teach is important for the teacher. Relating this to primary Mathematics, the teacher is supposed to be familiar with the cognitive, affective and psychomotor aspects of the goals and objectives of the subject, all these domains should be equally emphasised so as to ensure all round development (Cruickshank, Jenkins and Metcalf, 2003).

Knowledge of the subject matter, according to Grossman (1995), affects both what and how to teach. Grossman illustrates this by saying that when deciding on what to teach, teachers do give wider coverage to areas in which they are more knowledgeable and downplay areas they know less. Additionally, if a teacher is equipped with adequate knowledge of the subject matter, he asks more critical and challenging questions, uses immediate and appropriate illustrations and is able to relate content to the real life situation of the learner. This is not to say that a significant positive relationship exist between knowledge of the subject matter and the academic performance of the learners (Cruickshank, Jenkins and Metcalf, 2003), but this will bring about effective teaching.

The knowledge of the goals and subject matter are good and important for teachers to teach effectively only when these are accompanied with knowledge of how to teach. Various theories about how learners learn and types of learners guide the decision making of professional teachers. Such teachers know strategies that works and why they work (Parkay and Stanford, 2004). Though there is the popular saying that no teaching method is the best, some teaching methods may fail totally in some given situations such as using lecture method with age 3 pre-scholars or play-way method with University students. There are many teaching methodologies and strategies but the one to be used at any given time is determined by many factors among which are learner-related, environmental related, subject matter related and so on. Therefore, it is expected of a professional teacher to study these factors and select the most appropriate method to reach his instructional goal. Of all the factors affecting students' learning, teacher related factors, especially the pedagogical knowledge, was found to be strong predictor (Slavin et al, 1995; Anderson and Pellicer, 1998; McBer, 2000 and Anderson, 2004). So, an effective teacher could be defined as that teacher that knows the goals of teaching, what to teach and how best to teach it so as to ensure learning.

Teaching in Nigeria is one of the professions that have the largest members at different levels. The number of people that cross to teaching from other types of profession increases daily. Despite the fact that teaching is not a lucrative job, people keep coming into it. One wonders whether these teachers know what exactly teaching is all about or what could be the main reason for people's influx into the teaching profession or is it ideal for one to go into the teaching profession without adequate training in the name of earning a living? For instance, in the United States of America where teachers are well paid and the work is challenging and interesting, one can understand why people would readily like to be teachers because, among other things, the environment is good enough and one would have no qualms standing up in the public and being identified as a teacher. Large numbers of these teachers claimed that they enter into teaching because of their desire to work with children (NEA, 2002). This is quite different from Nigeria where, among all categories of workers, teachers are the least paid, with the society looking down on them and the environment where they work (school environment) largely decrepit while the government and other stakeholders keep silent and unable to address the situation adequately. As claimed by the Americans, the desire to work with children, which would also imply 'to see to the development of the children,' is the most important driving force needed by anybody in the profession to be able to teach effectively. Ejieh (2005) investigated reasons for pre-service teachers' entry into the Nigerian primary teacher education programme and it was discovered that those reasons given by the students did not suggest genuine interest in teaching as a career. It is apparent that about half of the students who were being prepared for the teaching profession had no plan to take up teaching as a career after completing their programme. Ogunsanwo and Salami (2007) supported these findings. With these reasons at the background, any institution that is involved in teaching these 'not interested' trainee teachers should build into their programme, excellent motivational strategies, most importantly, in the mode of teaching (Khazanov, 2007).

2.2.2 Teacher Education and Preparation of Teachers for Primary Education

In the World Conference on Higher Education (1998) the missions and functions of higher education were clearly stated and in the article 1 which states as follows:

Article 1 - Mission to educate, to train and to undertake research

It was affirmed that the core missions and values of higher education, in particular the mission to contribute to the sustainable development and improvement of society as a whole, should be preserved, reinforced and further expanded, namely, to:

(a) educate highly qualified graduates and responsible citizens able to meet the needs of all sectors of human activity, by offering relevant qualifications, including professional training, which combine high-level knowledge and skills, using courses and content continually tailored to the present and future needs of society;

(b) provide opportunities (*espace ouvert*) **for higher learning and for learning throughout life,** giving to learners an optimal range of choice and a flexibility of entry and exit points within the system, as well as an opportunity for individual development and social mobility in order **to educate for citizenship and for active participation in society,** with a worldwide vision, for endogenous capacity-building, and for the consolidation of human rights, sustainable development, democracy and peace, in a context of justice;

(c) **advance, create and disseminate knowledge** through **research** and provide, as part of its services to the community, relevant expertise to assist societies in cultural, social and economic development, promoting and developing scientific and technological research as well as research in the social sciences, the humanities and the creative arts;

(d) help **understand, interpret, preserve, enhance, promote and disseminate national and regional, international and historic cultures,** in a context of cultural pluralism and diversity;

(e) help protect and enhance **societal values** by training young people in the values which form the basis of democratic citizenship and by providing critical and detached perspectives to assist in the discussion of strategic options and the reinforcement of humanistic perspectives;

(f) contribute to the development and improvement of education at all levels, including through the training of teachers.

Article 1, section f, gives the mandate to all teacher training institutions all over the world. In Nigeria, there are two major institutions responsible for the preparation of teachers for primary education, viz, the Colleges of Education and the Universities (NCCE, 2009; Ejieh, 2005). However, over the years, since the previous Teacher Training Colleges were eradicated, the Colleges of Education have been producing more primary school teachers than the universities (Ejieh, 2005). Speculatively, there are many reasons that accounted for this. One, it could be as a result of the fact that the unit/department of Early Childhood Education (More appropriate Early Childhood and Primary Education) in the universities are relatively new (Ejieh, 2005). In the past, graduate teachers from universities teach in the secondary schools, since the Nigeria Certificate in Education (NCE) is the minimum qualification a teacher would have to be able to teach in primary school (NCCE, 2009, FGN, 2004). The in-service teachers that had Grade 11 certificate and many secondary school leavers that aspire to teach in primary school prefer to go to the Colleges. Lastly, it could be as a result of the fact that it is easier to gain admission into the Colleges than the Universities; so, students, instead of wasting many years at home seeking admission into the university, prefer to go to a College first and taking a degree later (Ejieh, 2005).

It has been documented that majority of the pre-service teachers in colleges of education do not want to be primary school teachers. Ejieh (2005) found out that a large number of pre-service teachers studying Primary Education Studies (PES) are doing so in order to gain admission to the universities. The reasons Ejieh gives for this is that teaching job in Nigeria is not encouraging and teachers in primary level of education are always looked down upon. In fact, those students seeking admission into colleges of education prefer to go for other programmes order than PES because they might gain employment in secondary schools. This explains why those special colleges for primary education always record low admission (Ejieh, 2005). The implication of this to this study is that a large number of students studying primary Mathematics might not be interested in teaching after all. The relevant question arising from this is: what is the implication of this scenario to the method of teaching pre-service teachers studying to become primary school teachers?

Rieg and Wilson (2009) submit that teaching at elementary schools (known as primary school in the case of Nigeria) is highly important to a nation because the nation's future depends on how well this is done. If this is so, Nigeria cannot afford to have primary school teachers that are not interested in the job they are doing at this level of her education, else, there is no future here. The only thing that can be done in order to raise a crop of ideal set of primary school teachers is to encourage the pre-service teachers through the instructional methods and strategies while in the training. Bain (2004) found out that the best college instructors should recognise that intelligence is expandable (students can learn) and can be motivated; they can be made to know their subjects extremely well, and they can become active scholars, by creating the kinds of environments that are supportive yet challenging, and developing a strong trust in the students while showing considerable care about their (students') learning and deep knowledge. The introduction of effective teaching in the colleges of education should be seen as the only panacea to the production of committed, conscientious and well informed primary school teachers as demanded by the National Policy on Education (FGN, 2004). It has been noted that one of the best ways to revitalize undergraduate education (teacher education inclusive) is by shifting pedagogy to a learner-centred focus and supporting an emphasis on the scholarship of teaching and learning (Rieg and Wilson, 2009). Rieg and Wilson (2009) argue further that active learning strategies are among the best teaching practices that can be adopted by college teachers. Good teaching in the college was viewed as the creation of those circumstances that lead to significant learning in the pre-service teachers; learning is said to be the end while teaching is supposed to be the means to that end (Finkel, 2000). All these submissions simply point to the fact that the use of lecture method only by the college teachers has been responsible for the continuous proliferation of sub-standard primary teachers in the country. Filene (2005) observed that pre-service teachers have grown up expectations and demand more than a 'talking head'. He stated that the best lecturers add variety into their teaching. Finkel (2000) noted that transmitting information from a teacher's head to a student's notebook is an inadequate objective for teacher training institution. Two reasons were raised for the failure of lecture method by Rieg and Wilson (2009): the first being that lectures presume students have had experiences they have not had and the second being that in the typical lecture, reflection is done by the lecturer and not by the students.

Several other instructional methods and strategies have been suggested by scholars. Discussion method – This is of 3 types, namely, the recitation that happens when an instructor asks close ended questions and the students provide the answer; the conversation that happens when the instructor attempts to get a lively exploration of the concept at hand and this leads to a seminar because the instructor aims for a substantive and probing analysis of the concept. These two were suggested as alternative method to lecture as modes of teaching the pre-service teachers (Filene, 2005). In addition to this, Mckeachie (2002) also suggested 'fish bowl' approach to discussion. This is where about six members of the class really take up the discussion and other members of the class write down the key points. Cooperative peer learning is another strategy found to be effective in the college classroom (Mckeachie, 2002; Rieg and Wilson, 2009). Bean (2001) also found role playing to be effective as a teaching strategy in the training of teachers. Filene (2005) suggests case study in which students learn to apply abstract theory and analysis to real-life situations. He also found manipulation of materials highly effective in the teaching of pre-service teachers. Therefore, using learner- centred activity-based and teacher demonstration approaches is not only appropriate but it can also ensure the preparation of motivated, conscientious and effective primary mathematics teachers. Drummond (1995) asserts that becoming an excellent college teacher is a continuous life-long professional challenge, but unfortunately, not many pre-service teachers will like to see the picture this way.

As it has been shown that teaching methods or strategies have a significant effect on the type of teachers produced in the colleges, so also is the assessment method. In fact, Bond and Falchikov (2007) submit that assessment rather than teaching has a major influence on students' learning. No wonder the pre-service teachers pay less attention to skill acquisition and more to memorisation.

Rieg and Wilson (2009) submit that assessment provides the following functions to the teaching/learning process: it focuses students' learning to what is expected of them; it is a means of providing feedback to the students; it is used to grade the students' performance; it serves as a means of motivating the students to learn the course material. Gibbs (1999) added that assessment helps to identify students' learning needs; it helps to improve the overall learning experiences; and it helps the instructor to assist the learners on how to improve their learning.

The following assessment tools could be used in the colleges: paper/pencil test, multiple choice, filling the blank, short answers, essay questions, oral test, take home activities, student port folios, students-graded-presentation, graded-project-works and experiments (Petress, 2007). Petress argue further that many college instructors rely on one or very few options of the assessment tools primarily due to the reality that the majority of the college teachers have minimal formal education training in teaching and testing strategies. Also, ability to design these assessment tools which is the responsibility of the teachers is highly challenging. Assessment that stresses skills demonstration in real environment (performance assessment) and those that measure knowledge of ways to solve actual problem (authentic assessment) are two of the many ways to address assessment in teacher education (Rieg and Wilson, 2009). It can also be observed that the major assessment tool in Nigeria Colleges of Education as well as faculty of education where primary school teachers are trained is paper/pencil test and examinations. It is only during professional practice that observation schedule is used, which is just 12 weeks out of 4-year or 3-year programme in the university and the college of education respectively. This points to the fact that assessment is not also encouraging the pre-service teachers who are in the colleges without willingness and interest. Both the teaching and the assessment methods mostly adopted in the colleges call for change.

2.2.3 Methods of Teaching Primary Mathematics Courses in Tertiary Institutions Generally and Colleges of Education in Nigeria in Particular.

Teaching and learning of Mathematics is an interesting and unique field on which to build our thinking about teacher education for two reasons (Korthagen and Kessels, 1999). The first is that the subject, Mathematics, is difficult for many learners and some teachers too because of its ‘abstract’ nature. The difficulty is compounded by inability to apply most of what have been learnt in the classroom to solve related real-life problems. At times too, learners cannot recognize where such mathematical concept can be applied in real life situation. This implies that there is need to find effective ways of making learners acquire necessary mathematical knowledge and skills in a way that helps them to apply it to solve life-related problems. This need has promoted the development of a theory about learning and teaching Mathematics that is directly relevant to classroom practices (Korthagen and Kessels, 1999). Secondly, mathematics as a field of study can be isolated from other knowledge areas. Here, psychologists have been rather successful in discovering the mechanisms underlying its learning. One of the most impressive, recent developments in mathematics education has been the introduction of so-called "realistic mathematics education" (Treffers, 1987; Freudenthal, 1991). This new mathematics pedagogy is characterized by a complete break with the traditional approach, which goes from "theory" (formulae, principles, rules, theorems) to application. In the traditional approach, learners are made to learn how to apply mathematical structures, formulae, axioms, theories and so on, developed in the past. Although with sufficient support they often succeed in working their way through a series of textbook problems, in ordinary life these learners are often unable to solve the simplest everyday problems, even when these problems are similar to those learnt in the mathematics lesson (Schoenfeld, 1987). In other words, a transfer problem was clearly evident in mathematics education. The great mathematician and mathematics educationalist Hans Freudenthal analyzed this transfer problem and pointed out how, in fact, the traditional didactic approach contradicted the essential nature of mathematics (Korthagen and Kessels, 1999). In his view, mathematics is not "a created subject" to be transferred to children, but "a subject to be created" (Freudenthal, 1978). When one pursues his line of thinking, mathematics becomes, or rather has always been, a human activity, based in the reality of the world around us. (This is why he called the approach "realistic"). Activity leads to consciousness of structures underlying the problems at hand. These structures, constructed by the learner, represent his or her idiosyncratic way of making meaning out of a problem situation. This means that these cognitive structures are closely connected to the way the learner will deal with similar problem situations in the future. This method of teaching Mathematics is based on the constructism.

Korthagen argued that the realistic approach towards mathematics, as summarized in Freudenthal (1991), started in the 70s in the Netherlands (Freudenthal, 1978). Through the work of the Freudenthal Institute at Utrecht University, it has now spread to many other countries as well, for example, to the United States, where it fits into ideas about changing mathematics education developed in the 80s. An important starting point in the realistic approach is the assumption that students can and should themselves develop mathematical notions on the basis of practical experiences and problems. The problems are presented within a context recognizable to children, and often taken from everyday situations. Emphasis is put on the practical use of mathematics, inquiry and reflection, group work, and hands-on activities. Freudenthal (1978, 1991) characterizes the resulting teaching and learning process as one of guided reinvention (a term also used by Fischer and Bullock, 1984). To put it in its shortest form, the realistic approach goes from practice to theory. An interesting aspect is that the gap between theory and practice disappears, although it is better to say that it is not created by the educational process itself, as is the case in the traditional approach. In cognitive psychological terms, one can say that the intended learning processes start from "situated knowledge" (Brown, Collins, and Dunguid, 1989), developed in the interaction of the learners with the problem situations, and that the concrete situations remain the reference points during the learning process. This immensely diminishes the classical "transfer problem" in application situations.

If the saying that a tree is better climbed from the base and not from the top is anything to go by, then, the problem of poor performance of students, especially at the primary and secondary level of education, would be better addressed by examining the teachers first so as to understand the method adopted to train them (Khazanov, 2007). The teachers could be understood if a closer look into how they are prepared is taken. UNESCO (1998) declares that there is a problem of skills-based training, quality in teaching, and employability of graduates of higher institutions nowadays. Thomas (2010) submits that scholars and stakeholders in education dissipate much energy on performance at lower level of education while they neglect the type of teaching and learning that take place in the higher institution where these teachers are prepared. But then, the fact remains that the way they are taught is the way they will teach.

Studies on the type of teaching method adopted by lecturers in the teacher training institutions have found out that the common method of teaching adopted at the higher institution generally and education institutions in particular is lecture method (Freudenthal, 1991; Cashin, 1990; Radford, 1991; Bizhan, 1996; Korthagen, 1993; Rieg and Wilson, 2009 and Salami, 2009). Therefore, there is need to pay attention to the method of teaching these lecturers. If we compare traditional approaches of teaching Mathematics in lower level of education and those of the teacher education system where theories are taught in a lecture method, there appears to be striking similarities. In Freudenthal's terms, one could say that in this traditional approach to mathematics teaching, knowledge about teaching is considered a created subject and not a subject to be created by the learner; that is, the student teacher.

As is the case in realistic mathematics education, the emphasis shifts towards inquiry-oriented activities, interaction amongst learners, and the development of reflective skills. Korthagen (1993) found that there is a belief by some mathematics educators that the realistic mathematics teacher preparation implies that theory will disappear from the teacher education curriculum and student teachers will have to reinvent the wheel over and over again, whereas the teacher educator's only task is to ask "what do you yourself think?" He argues further that this belief is based on a complete misunderstanding of the processes involved in a realistic approach. During the learning processes involved, the teacher educator has an important role, although this is completely different from the traditional role of the lecturer. The kind of support which he or she should offer (including theory!) has to be very much adjusted to the specific problems the student teachers are having. As a consequence, the nature of fruitful "theory" becomes completely different from that in the traditional approach.

Bembenutty (2009) submits that the schism between current state-of-the-art methodology and the actual methodological skills of many lecturers, particularly those in the faculty of education, is increasing at a rapid rate. The major advantages associated with lecture method include: it is efficient in communicating large amounts of information to many listeners; it gives room for instructor control; provides opportunity for face-to-face contact with students; encourages time management and is non-threatening to students (Cashin, 1990; Radford, 1991; McKeachie, 2002). Despite all these, it has one disadvantage that makes it inappropriate for pre-service teachers, and it is that it has a significant negative influence on the way the pre-service teachers teach the younger ones (Akinbote, 1999; Cruickshank, Jenkins and Metcalf, 2003). The disadvantage of lecture method to pre-service primary mathematics teachers is more than one. Finkel (2000) identified two reasons why lecture method fails: (1) the lecturer presumes that students have had experiences that they have not had and (2) reflection is done by the lecturer not by the students. Learners' cognitive faculties are thus not engaged, resulting in what is termed 'rote drilling, memorization or cramming' (Alexander, Van Wyk, Bereng and November, 2009).

Mathematics, being an abstract subject, is better taught in concretized way. Lecture method fails to inculcate into the pre-service teachers the skills of presenting a concretized mathematics lesson. The subject is learnt better through life related activities that aim at fostering strategic competency, adaptive reasoning and productive disposition which is learner-centred ((Khazanov, 2007; Filene, 2005). Lecture method is teacher-centred method and this is all the pre-service teachers will be able to design when teaching the younger students (Rieg and Wilson, 2009; Salami, 2009). This could be the reason why Masikunis, Panayiotidis and Burke, (2009) opine that an effective teaching cannot be attained by transmission model (lecture method) which is characterised by students sitting in rows, facing the lecturer who is considered 'the sage on the stage', it can only give surface approach to learning and no deep understanding could take place. Filene (2005) added that at this level of education (higher education), students have grown up expecting or even demanding more than a 'talking head'. To follow this up, Harris and Cullen (2008) and Rieg and Wilson (2009) submit that one of the ways to revitalise undergraduate education is by shifting pedagogy to a learner-centred focus and supporting an emphasis on the scholarship of teaching and learning.

2.2.4 Pupil-centred Activity-based, Teacher Demonstration and other instructional strategies and planning for delivering primary Mathematics and primary mathematics methodology courses in teacher training programmes

One of the objectives of primary education in Nigeria is the inculcation of permanent literacy and numeracy (FGN, 2004). To achieve this, especially the numeracy aspect, primary Mathematics is made one of the core subjects in primary education in Nigeria (FGN, 2004; NTI, 2007). This is as a result of the type of knowledge and skills Mathematics is capable of imparting to the recipients, especially at the early ages. Bahr and Garcia (2010) opine that Mathematics is capable of equipping children with knowledge and skills of problem solving, reasoning and proving, representation, connections as well as communication. Unlike the way Mathematics was taught and learnt in the past century, where a mathematics literate person is seen as "knowing Mathematics", the focus of teaching and learning the subject is now on "doing Mathematics" (Schoenfeld, 1992; Nelson and Sassi, 2007; Bahr et al, 2010). Baki (1997) refers to 'knowing Mathematics' as procedural knowledge and 'doing maths' as conceptual knowledge. Conceptual knowledge is preferable because it involves the acquisition of the knowledge and ability to adopt it to solve life-related problems. Therefore, teaching at this level shall be by practical, exploratory and experimental methods (FGN, 2004).

Studies have shown that primary Mathematics is badly taught and consequently poorly learnt (Odu, 1985; Baki, 1997; Buck, 2004; ESA, 2004; NTI, 2007). It has been identified that many children do not enjoy learning primary Mathematics and many teachers fear it too and that the teaching of the subject is not associated in any meaningful way with the real life of the learners (Odu, 1985). Pica (2008) submits that today, children are spending time passively interacting with "educational" products instead of engaging in active, sensory experiences because some parents are excited by the "evidence" that their children are "learning" via flashcards, DVDs, and computer programmes. They are asking for more of the same in their children's early schooling not knowing that what they observed in the children is a result of memorization. Effective learning involves comprehension and until a child is developmentally ready to understand what the numbers, letters, and words he is reciting represent, that is, when the information has some relevance to his life, there will be no comprehension. Pica furthers the argument by saying that some rote learning has its place, of course; it's how most of us learnt the multiplication tables and the state capitals; however, unless a child is going to grow up to become a TV game show contestant, memorizing facts will have little use in life once s/he's passed all the required tests.

A study conducted by King's College, London, on effective teaching of primary numeracy aimed to investigate the distinctive characteristics of effective teachers of numeracy (Askew, Brown, Johnson, Rhode and William, 2005). It is one of a small number of projects where effectiveness is defined on the basis of learning gain. This implies that teachers were identified as highly effective if the pupils in their classes had, during the year, achieved a high average gain in numeracy in comparison with other classes from the same year group. In order to identify key factors which enabled these teachers to be effective, the project explored the knowledge and the beliefs which underpinned their teaching. These concerned what it means to be numerate, the relationship between teaching and pupils' learning of numeracy and which presentation and intervention strategies are effective. The following is the summary of their findings:

Highly effective teachers believed that being numerate requires:

- *having a rich network of connections between different mathematical ideas;*
- *being able to select and use strategies which are both efficient and effective*

They used corresponding teaching approaches which:

- connected different areas of Mathematics and different ideas in the same area of Mathematics using a variety of words, symbols and diagrams;
- used pupils' descriptions of their methods and their reasoning to help establish and emphasise connections and address misconceptions;
- emphasised the importance of using mental, written, part-written or electronic methods of calculation which are the most efficient for the problem in hand;
- particularly emphasised the development of mental skills.

Highly effective teachers believed, in relation to pupils' learning, that:

- *almost all pupils are able to become numerate;*
- *pupils develop strategies and networks of ideas by being challenged to think, through explaining, listening and problem solving.*

They used teaching approaches which:

- ensured that all pupils were being challenged and stretched, not just those who were more able;
- built upon pupils' mental strategies for calculating, and helped them to become more efficient.

Highly effective teachers believed, in relation to teaching, that:

- *discussion of concepts and images is important in exemplifying the teacher's network of knowledge and skills and in revealing pupils' thinking;*
- *it is the teacher's responsibility to intervene to assist the pupil to become more efficient in the use of calculating strategies.*

These teachers used teaching approaches which:

- encouraged purposeful discussion, in whole classes, small groups, and with individual pupils;
- used systematic assessment and recording methods to monitor pupils' progress and to record their strategies for calculation, to inform planning and teaching.

Teachers who gave priority to pupils acquiring a collection of standard arithmetical methods over establishing understanding and connections produced lower numeracy gains. These teachers referred frequently to differences in pupils' ability to remember what was taught, and used teaching approaches which:

- dealt with areas of Mathematics discretely;
- emphasised teaching and practising standard methods in isolation and applying these to abstract or word problems without considering whether there were alternative, more efficient ways of solving particular problems;
- used assessment mainly as a check that taught methods had been learnt rather than as a means of informing subsequent teaching.

Teachers who were satisfied with pupils using any method irrespective of whether the method was efficient and effective, and who delayed the introduction of more abstract ideas until they felt a child was ready for them, also produced lower numeracy gains.

These teachers used teaching approaches which:

- encouraged pupils to use practical equipment or any other method they felt comfortable with;

- moved from use of equipment to more formal written methods without putting much emphasis on mental methods;
- dealt with areas of Mathematics discretely, so as not to confuse the pupils.

The teachers' beliefs and understandings of the mathematical and pedagogical purposes behind particular classroom practices seemed to be more important than the forms of practice themselves.

For example, highly effective, effective and moderately effective teachers in the study all used mental tests and used written exercises to practise skills. Whole class question-and-answer teaching styles were used by both highly effective and comparatively less effective teachers, as were individualised and small group forms of organisation. Setting across an age group was used in schools with both high and low proportions of highly effective teachers. The same published mathematics schemes were used by highly effective and comparatively much less effective teachers.

Highly effective teachers had knowledge, understanding and awareness of conceptual connections within and between the areas of the primary mathematics curriculum which they taught. However, in this study, being highly effective and displaying this kind of mathematical knowledge were not associated with levels of qualifications in mathematics.

Some, but not all, comparatively less effective teachers of numeracy displayed knowledge that was:

- compartmentalised
- framed in terms of standard procedures, without the underpinning of conceptual links.

For example, some teachers were able to convert from a fraction to decimal without having thought about when one should be used in preference to the other, or whether the two forms of representation are always equivalent.

Highly effective teachers were much more likely than other teachers to have undertaken mathematics-specific continuing professional development over an extended period, and generally perceived this to be a significant factor in their development.

Teachers described such courses as having led to major shifts in their thinking, achieved by discussion with other teachers and by talking to individual pupils in their own school as part of an assignment. These teachers displayed very positive attitudes to Mathematics.

In some schools, experienced and highly effective staff were able, over time, to assist other teachers to become more effective through working closely with them in planning and evaluating detailed teaching approaches, and by working together in the classroom.

In most schools in the sample, there was a mixture of highly effective and less effective teachers of numeracy. mathematics co-ordinators might themselves be highly effective but often did not significantly influence other teachers through perceived lack of opportunity to work with them individually. In one school where resources had been organised to make this possible with staff over a sustained period, there was evidence of significantly higher numeracy standards than in comparable schools, both in absolute and in value-added terms.

It is a basic fact that the proper implementation of any curriculum depends on the quality of the teacher (Buck, 2004; FGN, 2004; NTI, 2007). Therefore, if the implementation of the primary Mathematics curriculum is to be effective, the need to update the knowledge of primary mathematics teachers on how to teach effectively is paramount (Saeed and Mahmood, 2002; Buck, 2004).

In Great Britain around 1990s, a study was conducted to investigate primary school teachers' understanding of Mathematics and its teaching. It was discovered that college mathematics is not targeted effectively to address practical teaching issues when needed (Brown, Mcnamara, Hanley and Jones 1999). This study also discovered that students desire recipe knowledge rather than repertoire skills. This situation explains what happens in Nigerian higer institutions where teachers of primary mathematics are trained. There are many Mathematics courses exposed to the pre-service teacher of primary Mathematics that have nothing to do with primary Mathematics. Examples of such courses in the colleges of education include calculus, ordinary differential equations, analysis I and II, and a host of others. Again, students prefer a lecture where knowledge is disseminated rather than the one that attempts to teach skills through assigning projects, hands-on activities and trail presentations. Brown et al, (1999) located incommensurability between the ways in which mathematics is presented in many official documents and the ways in which it is often depicted during college training and in certain curriculum. Some reported difficulties in mathematics education were pointed out. These have to do with mathematics education research in harmonising perceptual and structural conceptions in the learning of Mathematics and in training of future teachers of Mathematics.

Research studies conducted by National Teachers Institute (NTI) and other non-governmental organizations have revealed that Nigerian schools is poorly resourced in both availability and adequacy of meaningful instructional materials for primary Mathematics and that the teachers have failed to demonstrate the requisite skills and knowledge for improvising and using the appropriate ones and that the assessment practice used by these teachers is ineffective. The continuous assessment recommended by the National Policy on Education has been reduced to continuous testing (NTI, 2007). This shows that there is general misconception that the purpose of education is the passing of public examination.

It could be inferred, from what has been said so far, that the teaching methods employed by primary mathematics teachers is not effective enough and that the teachers have not been improvising and using instructional materials. This could be traced to the training received by the teachers since they were not taught using instructional materials (Radford, 1991; Bizhan, 1996; Buck, 2004; Salami, 2009) and they were usually taught with no hands-on experience, no practical mathematics work, so the popular saying holds, you teach the way you were taught (Akinbote, 1999, Cruickshank, Jenkins and Metcalf, 2003). Any lesson delivered by these teachers will only allow the pupils to do mathematics following the teacher's algorithm.

Activity-based instructional strategy is based on constructivist theory which is predicated on the belief that learners are capable of constructing their own knowledge if allowed to interact, explore or be actively involved in the process of learning (Sowell, 1989; Richardson, 1997; Macdonald and Twining, 2002; Reshetova, 2004; Dada, Granlund and Alant, 2006; Marley, Levin and Glenberg, 2010). It allows individuals to create their own new understandings, based upon the interaction of what they already know and believe and the phenomena or idea with which they come into contact. It is a descriptive theory (that is, it tells the way people learn or develop) and not a prescriptive theory (that tells the way people should learn) (Richardson, 1997). Activity-based instructional strategy has been used and found effective by many scholars at different levels (Suydam and Higgins, 1977; Wearne and Hiebert, 1988; Fuys et al, 1988; Sowell, 1989; Fuson, 1992; Thompson, 1992; English and Halford, 1995; Cubey and Dalli, 1996; Reshetova, 2004; Dada, Granlund and Alant, 2006; Marley, Levin and Glenberg, 2010). Activity-based learning, according to Pica (2008), is the process of exploration and discovery, of acquiring knowledge, of knowing how to acquire it (no one can memorize all the facts!). It will serve a child endlessly, and, moreover, active, authentic learning is far more likely, than rote learning, to foster a lifelong love of the learning process (Jensen, 2008). Activity-based instructional strategy is a kind of learner-centred instructional strategies which has been shown to be effective than teacher-centred instructional strategy.

Markusic (2009) submits that today, when students are no longer viewed as “tabula rasa,” teaching philosophy should be learner-centred. But what are the characteristics of a learner-centred instruction in the classroom? The best way to describe a learner-centred classroom instruction is to compare and contrast it with its opposite, the teacher-centred instruction. Here are 2 ways that the learner-centred instruction differs from the teacher-centred one.

1. Knowledge direction – The two paradigms of classroom instruction, teacher-centred and learner-centred, differ significantly in knowledge direction in the following areas: **Source of knowledge** – In the teacher-centred classroom instruction, knowledge primarily comes from the teacher. The teacher is the major source of information. On the other hand, in the learner-centred paradigm, knowledge is the combined efforts of the teacher and the students. Under the guidance of the teacher, the students synthesize the gathered information using problem solving, critical thinking, and inquiry skills.

Acquisition of knowledge – In the teacher-centred paradigm, teaching strategies are usually based on lecture or exposition. This paradigm places much emphasis on the faster pace and greater bulk of knowledge transmitted from teacher to student. But in the learner-centred classroom instruction, greater emphasis is laid on the meaningfulness of knowledge. Students acquire knowledge to address real-life issues and problems.

Receipt of knowledge – In the teacher-centred classroom, students receive knowledge passively, while in the learner-centred classroom, the students are actively involved in seeking out knowledge.

2. Assessment approach – The fundamental purpose of conducting assessment in a teacher-centred classroom is similar to that of the learner-centred one. The fundamental purpose is to increase the effectiveness of instruction in the classroom. However, the approaches to conducting assessments are different in these two paradigms.

Assessment tools – Since the teacher is the primary source of knowledge in a teacher-centred instruction, there are only two kinds of answers – the right and the wrong. Thus, the tools used for assessment are those that clearly delineate the right answer from the other answers. On the other hand, in the learner-centred classroom, the importance of right answers is overshadowed by the importance of creating better questions. Thus, assessment tools vary to embrace the multiple facets of learning. Besides paper tests, there will be portfolios, performance tests, and others.

Assessment functions – In a teacher-centred paradigm, the instruction follows a distinct step by step procedure. Once the subject is taught, assessment follows. The results of the tests are recorded and the function of the assessment was to monitor the academic progress of the students. But in the learner-centred paradigm, assessment is intertwined with classroom instruction. The results of a test are used to discover learning difficulties. The functions of the assessment are to diagnose learning problems and to encourage better learning.

Macdonald and Twining (2002) give three key issues for the assessment of activity-based learning. These are:

i. Assessment of activity-based learning must reflect course philosophy: that is, it must be aligned with the exercise of active learning, responsibility and autonomy;

ii. Assessment is essential in creating learning opportunities at critical points: the close integration of activities with assessment will ensure students' participation

iii. Assessment provides a vital opportunity for feedback, helping to complete the reflective learning cycle.

Recent brain research is confirming what many educators have believed all along: the mind and body are not separate entities. Jensen (2008) confirms that not only do children learn by doing and that movement is the child's preferred mode of learning but also that physical activity activates the brain much more than doing seatwork or paper/pencil work. While sitting increases fatigue and reduces concentration, movement feeds oxygen, water, and glucose to the brain, optimizing its performance. Furthermore, learning by doing creates more neural networks in the brain and throughout the body, making the entire body a tool for learning (Hannaford, 2005).

Marley et al (2010) explain that the benefits of activity-based learning strategies are due to motoric encoding (Citin Gengelkamp and Zimmer, 1989). The explanation is that a motor memory system is present and it provides an additional pathway for the encoding and retrieval of target information to and from long-term memory. The second explanation that was given was that activity-based learning strategies result in distinct events that are contained within episodic memory (Citing Tulving, 1983). According to this view, memories for activities that one has engaged in are contained in person-relevant autobiographical memories. These two views make it possible for whatever learnt through activity-based to remain a permanent fixture of ones behaviour. Besides, active learning is also more fun for young children, which means it matters more to them (Pica, 2008).

Pica (2008) discussed how activity-based instructional strategies, especially the pupil-centred type where materials are manipulated, is far better than using computer or any other ICT gadget to learn. Pica believed that when a child bangs on pots and pans, she learns about cause and effect. She's also experimenting with sound and the strength of her muscles. A child learns more from manipulating blocks and puzzle pieces than from manipulating images on a screen; he can't feel the images on the screen. Cutting, pasting, and scribbling provide more fine motor coordination, which a child will need later for writing and keyboarding, than does clicking on a computer mouse. Helping to set a table or pouring water or sand from one container to another, both teach more mathematics concepts in a meaningful way. The sights, sounds, textures, and smells of the outdoors engage children in relevant lessons on scientific principles. When you give children the opportunity to physically move over, under, around, through, beside, and near objects and classmates, they better comprehend prepositions (those little words so essential to language and life). When a child performs a "slow walk" or skips "lightly," adjectives and adverbs become real to her and more than abstract concepts. When children can physically demonstrate action words like stomp, pounce, stalk, or slither or descriptive words like smooth, strong, gentle, or enormous, word comprehension is immediate and long lasting. The children learn these words in context; they are no longer a mere collection of letters. This approach promotes emergent literacy and a love of language. Similarly, if children take on high, low, wide, and narrow body shapes, they'll have opportunities to understand these quantitative concepts (and opposites). When they act out the lyrics to "Roll Over" (There were five in the bed, and the little one said, 'roll over' . . .), they can see that five minus one leaves four. The concept of magnetism will be much more fascinating to children if they play with magnets and then pretend to be them. The same fascination and understanding result when children engage in hands-on activities with such scientific concepts as gravity, flotation, evaporation, balance and stability, or action and reaction. When teachers use activities like these in the classroom, they are teaching to the whole child, using the physical and social-emotional as well as the cognitive. This results in enduring and meaningful lessons and children who will move in leaps and bounds toward becoming lifelong learners (Pica, 2008).

Some scholars have however provided warning regarding how to use activity-based strategy effectively. Walkerdine, (1982) and Stigler and Baranes (1988) for example warned that the intervention of a human teacher and the availability of manipulative materials are important when using activity-based strategy. Ball (1992) submits that teachers sometimes overestimate the value of manipulation because adults are able to see the mathematical concept or processes being presented but children may not have the 'adult eyes'.

Demonstration strategy allows a learner to view a real or lifelike example of a skill or procedure to be learnt (Loeffler, 2010). It has been described as a method of teaching that relies heavily upon showing the learner a model performance that he should match or pass after he has seen a presentation that is live, filmed or electronically operated (Rodriques, 2010). Demonstration instructional strategy facilitates faster and and more effective learning when students are shown how the job is done by using the actual tools and materials they are expected to work with. Unlike activity-based, it calls for less supply (Rodriques, 2010). This is likely to be helpful in the Nigerian situation where there are large classes and materials are not supplied. Since the learners, in the focus of this study, are the pupils in primary school, this strategy also allows teacher to control potentially dangerous materials instead of leaving the pupils to do this (Loeffler, 2010).

Demonstration strategy employs the demonstration or "doing" method to deliver a teaching that involves learning of skills like teaching itself. Teaching activities are more of skilful activities than ordinary knowing. Teacher demonstration allows step-by-step presentation of the procedures in a job task, using the exact physical procedures if possible. When used in a mathematics classroom, it enables the mathematics teacher to demonstrate the concept as it relates to real life situation which complements the paper/pencil classroom exercises (Loeffler, 2010). While demonstrating, a teacher is able to explain the reason for and the significance of each step made. To make this strategy more effective, mathematics teacher has to plan the demonstration so as to be sure to show all the steps in the proper sequence and to scaffold the mathematical implication of the steps. If a teacher has to give the demonstration before a large group or if the learners might have trouble seeing because of the size of the equipment involved or the class, enlarged devices could be used or the teaching should come up in groups. It is also advised by Loeffler that learners should be allowed to repeat the procedure in a "hands on" practice session to reinforce the learning process. This could be achieved with pre-service teacher, by organizing peer teaching for them so as to allow them demonstrate with necessary materials even before they are allowed to go for the first Professional Practice. By immediately correcting the pre-service teachers' mistakes and reinforcing proper procedures, the learning is sure to be effective and faster (Mckee, Williamson and Ruebush, 2007). The direct demonstration approach is a very effective method of instruction, especially when learners have the opportunity to repeat the procedures (Loeffler, 2010).

Loeffler (2010) also observes that the basic method of instruction for teaching skill-based subject like "Teaching" itself is the demonstration-performance method of instruction. This method is recommended for teaching a skill because it covers all the necessary steps in an effective learning order. The demonstration step gives learners the opportunity to see and hear the details related to the skill being taught. Those details include the necessary background knowledge, the steps or procedure, the nomenclature and the safety precautions. The repetition of steps helps the average and slow learners and gives the learners an additional opportunity to see and hear the skill being taught (Mckee, Williamson and Ruebush, 2007; Loeffler, 2010). Relating this to primary Mathematics, it will allow the pre-services to understand the sources and derivations of those formulae, the relationship of the concepts and the real life situations and where and when to apply the skills learnt. The performance step gives all trainees the opportunity to become proficient. In short, this method is recommended because it leaves nothing to chance (Loeffler, 2010). For convenience, the techniques for imparting skills are presented in steps, rather than activities. When setting up an instructional plan, a teacher should understand that the steps are not to be followed hook-line-and-sinker in the sequence presented; instead they should choose the steps in the sequence best suited to the needs of the learners.

Some general hints were given for any teacher using direct instruction (Heming, 2004; Loeffler, 2010). Some of these are that teachers should ensure that every effort to get learners to observe correct procedures the first time they try a new task. The most effective learning results when learners use a skill immediately after it has been taught. Therefore, as soon as a teaching skill is taught, it is important to have them practice the skill. Safety precautions become highly important to teaching when materials are to be manipulated. Teacher must have taught the safety precautions just before reaching the point in your demonstration where it applies. State the reasons for the precautions so that the pre-service teachers will understand the need for compliance. Patience is a virtue for any petty officer. If it does not come naturally to you, you must train yourself to be patient. A slow learner may never acquire the knowledge or skill you are trying to impart if one is impatient. Avoid sarcasm toward poor demonstrators; that person may be trying harder than you suspect. Nothing exhausts the patience of the expert as much as the fumbling attempts of a beginner; however, the instructor must patiently demonstrate and explain until the learner acquires the needed competence. "Good instruction" means a more effective crew, and such an asset justifies any amount of patience. If you find that your learners have not learnt what you tried to teach them, do not react as if they disobeyed orders. If learners do not understand a certain lesson or operation, that could indicate a poor job of teaching. The old saying, "If the learner hasn't learnt, the teacher hasn't taught" might apply in some situations (Loeffler, 2010).

The effectiveness of demonstration was initially debated and was assumed to be on affective domain more than any learning domain (Mckee, Williamson and Ruebush, 2007). A meta-analysis of educational studies that examined the efficacy of demonstration revealed that it is marginally more effective than lecture method or direct instruction. For instance, sometime around 1983, the effectiveness of demonstration was tested at Saudi Arabian schools. It was shown that demonstration is effective in improving students' attitude as well as their academic performance (Mckee, Williamson and Ruebush, 2007). Glasson (2006) carried out a research to examine the effect of hand-on and teacher demonstration laboratory methods on science achievement in relation to reasoning ability and prior knowledge. Teacher demonstration was also found effective in teaching. Likewise, Thompson and Soyibo (2010) investigated the effects of lecture, teacher demonstrations, discussion and practical work on 10th graders' attitudes to chemistry and understanding of electrolysis. This study also shows that those exposed to the experiments, that is, the use of teachers' demonstration and other strategies have better attitude to chemistry than those exposed to conventional strategy.

The commonly adopted teaching method for Mathematics, the traditional chalk-and-talk method, does not allow pupils to manipulate, actively explore materials and their environment. They are only active when copying the notes or when doing some exercises following the teachers given method. This type of teaching has been shown not to be effective in teaching

Mathematics (Akinsola, 1994; Richardson, 1997; Oladeji, 1997; O'Brien, 1999; Aremu, 2001; Saeed and Mamood, 2002; Akinsola, 2002; Awofala, 2002; Olosunde, 2009). This type of teaching, termed transmission model by Richardson (1997), is said to promote neither the interaction between prior and the new knowledge nor the conversations that are necessary for internalization and deep understanding. The information acquired from traditional teaching, if acquired at all, is usually not well integrated with other knowledge held by the students. Thus, new knowledge is often only brought forth for school-like activities such as examinations and written tests, and ignored at all other times.

Primary education forms the bedrock upon which other levels of education are built. For this reason, the teaching of all school subjects at the primary school level should lay a solid foundation. This could be the reason why the Federal Government of Nigeria, in the National Policy on Education, advocates hands-on teaching at the primary school level (FGN, 2004). One of the teaching strategies that could make this happen is activity-based teaching **(**Fuson, 1992; Thompson, 1992; English and Halford, 1995; The Ontario Curriculum Unit Planner, 2002; Epstein, 2007; Engel, 2002**).** . It is believed that getting pupils involved with realistic whole situations will help them form appropriate schema and mental models. These more complete internal representations are believed to facilitate their later application in their newly acquired knowledge and skill (Thornton, 2001; Merrill 2007). Corbett and Kearns (2003) submit that activity-based lesson is effective because it involves the following four things: first, Modeling – which involves an expert carrying out a task so learners can observe; second, Coaching – which includes observing learners and offering suggestions; third, Articulation – which has to do with getting students to articulate knowledge and reasoning behind it, and fourth, Exploration – which encourages learners to engage in problem-solving. Activity-based lesson is capable of increasing lower achieving pupils' confidence in and enjoyment of Mathematics, aids memory and engagement and working collaboratively improves quality of lesson (Russell et al, 2008).

It has been established by many research findings that at present teachers are prepared in such a way as to develop procedural knowledge of Mathematics (Baki, 1997; DiSessa, 1985; Amobi, 2006). Procedural knowledge assumes that the teacher processes the total mathematics knowledge which he has to dictate to the pupils. This, in other words, is known as teacher centred method of teaching. Having discovered that this method of teaching is less productive, DiSessa (1985), Akinsola (1994), Richardson (1997), Oladeji (1997), Akinsola (2002), Awofala (2002), Amobi (2003), Wendling and Chadwick (2008) and Olosunde (2009) report that some teacher education institutions around the world have shifted to what is called conceptual knowledge of Mathematics. This type of mathematics knowledge cannot be disseminated directly to the learner but can only be constructed by the learner (O'Brien, 1999; Baki, 1997). Preparation of mathematics teachers to acquire conceptualised knowledge of Mathematics brings in activity-based lessons to the teacher preparation programme (DiSessa, 1985; Baki, 1997; Wendling and Chadwick, 2008). There is an assumption that students, such as those in pre-service mathematics teacher education, bring understandings into the classroom that need to be adjusted, added to or completely altered. The teacher's role is to facilitate this cognitive alteration through designing tasks and questions that create dilemmas for students (Richardson, 1997).

Two quite different forms of constructive teacher education are being advocated today. One form attempts to teach students how to teach in a particular constructive manner (Black and Ammon, 1992; Schifter and Simon, 1992). Another form of constructive teacher education involves working with teachers and pre-service students to help them understand their own tacit understandings, how these have developed and effects of these understandings on their actions (Richardson, 1992 and 1994). This second form attempts to model a manner of involving pre-service teachers in investigations of premises and perspectives so that they will be able to use it when they begin to teach (Richardson, 1997).

2.2.5 Numerical Ability of Primary Mathematics Teachers as Related to their Teaching Practices

There are some school subjects that are so straight forward that students can read and understand them, with little or no assistance from teacher, and gain the knowledge of such subjects. Subjects like Christian Religious Knowledge, Social Studies, Health Education, and so on fall in this category. But subjects that require calculations, rules, intensive thinking, that are abstract in nature like Mathematics, rely heavily on the teacher to reveal their knowledge to students. Therefore, a teacher of Mathematics must have in-depth knowledge of the subject. Lee

Shulman's categorises teachers' knowledge into three, namely, Subject Matter Knowledge (SMK), Pedagogical Content Knowledge (PCK) and Curriculum Knowledge (CK) (Goulding, Rowland and Barber, 2002). The SMK is the one that is referred to as primary mathematics numerical ability in this particular study. SMK, or what is termed numerical ability of the teachers, is the amount and organization of the knowledge per se in the mind of the teacher. It is further analysed into substantive knowledge (the key facts, concepts, principles and explanatory frameworks in a discipline, here, Mathematics) and syntactic knowledge (the rules of evidence and proof within the discipline) (Goulding, Rowland and Barber, 2002).

Goulding et al observe that students who have multiple representations for mathematics ideas and whose mathematical knowledge is rich will be able to draw upon these, both in planning and in spontaneous teaching interactions. In such cases, it could be argued that the students' subject matter knowledge is ripe for exploitation and that in turn the experience of teaching will feed back into and enrich subject matter knowledge. Belief about the nature of Mathematics may be tied up with SMK in the way in which teachers approach mathematical situation. If they believe that it is principally a subject of rules and routines which have to be remembered, then, their own approach to unfamiliar problems will be constrained and this may have an impact on their teaching. If teachers lack confidence in their SMK, they may avoid risky situations in the classroom and be inhibited in responding to children's unexpected questions. They might also seek refuge by opting to teach younger children, where they may feel less daunted by the demands of the mathematics curriculum, and deny themselves the opportunity to engage with materials which could challenge and develop their own SMK.

British Educational Policy-makers have believed for some time that strengthening primary teachers' SMK will contribute to the teachers' effectiveness (Alexander et al, 1992, Office for Standards in Education [OFSTED], 1994). In an evaluation of the first year of the National Numeracy, it was once discovered that there were weaknesses in teachers' subject knowledge, particularly those that relate to the teaching of progression from mental to written method, problem solving techniques, fractions, decimals and percentages. Based on this, adequate attention was focused on teachers' SMK at the training stage.

In another study, Brown et al (1999) identified primary trainees' anxiety about Mathematics as a major issue. The National Board for Professional Teaching Standard (NBPT,

2001) as quoted by James, Raths and Roy (2005) shows that knowledge of subject matter, which is also known as *mathematics ability* in this study, is an important prerequisite to effective teaching. This is in line with the submission of Kennedy (1997). In this respect, students of primary mathematics in the colleges of education are made to take the primary mathematics contents courses in PES 113, 122, 222, and 324 (NCCE, 2009). In the year 2010 to be precise, a study was conducted in the United States that compared the preparation of elementary school teachers in the USA and other countries around the world. It was found that elementary mathematics teachers in countries like the USA, Germany, Norway and Russian Federation have low knowledge of mathematics contents meant for elementary school pupils (Babcock et al, 2010). Studies concerned with teacher effectiveness in Mathematics have found that there are significant differences between teachers: Sullivan and McDonough (2002) found evidence that children from similar backgrounds had markedly different experiences at school (Carroll, 2005). The different experiences could only be attributed to differences between teachers. Another similar study carried out by Siemon, Virgona, and Corneille (2001) in a Victorian Study of Middle Schools found that there was as much difference within schools, that is, from class to class, as there was between schools, in student achievement (Carroll, 2005). One of the major factors that might have been bringing about the differences in the effectiveness of the teachers must have been their knowledge of elementary mathematics content.

Askey (1999) tried to depict the importance of numerical ability in the various scenarios such as the knowledge of primary mathematics teachers in Subtraction with Regrouping, Multi-digit Multiplication, Division by Fractions and the Relationship between Perimeter and Area. These are illuminating examples. They show the teachers' deep mathematical knowledge and their ability to represent mathematical problems to students. This type of knowledge cannot be acquired by reading the mathematical textbooks written for the children as many of our teachers do now. Therefore, for effective teaching of primary mathematics, teachers' numerical ability is highly important.

To many, primary Mathematics is a very simple subject for adults because it is all about simple arithmetic. Because of this, there is the assumption that any adult with higher education experience should be able to teach it. This submission could only be given by those with shallow syntactic knowledge of primary Mathematics because there are some mathematical operations that are very difficult to explain which call for high knowledge of numerical operations. For instance, what is the explanation for the fact that a negative number multiply by a negative number produces positive number? That is, -3 X -5 = 15. Why? How? Why not -15? Even those with Bachelor Degree in Mathematics might not be able to provide this explanation. But if a primary school child should ask, the explanation must be provided else, such a child might see Mathematics as a subject full of magic.

In trying to explain the above problem, Askey (1999) used various ways, below is just one of them:

…Another explanation. Let us write the numbers

1, 2, 3, 4, 5,...

and the same numbers multiplied by three give:

3, 6, 9, 12, 15,...

Each number is bigger than the preceding one by three. Let us write the same numbers in the reverse

order (starting, for example, with 5 and 15):

5, 4, 3, 2, 1

15, 12, 9, 6, 3

Now let us continue both sequences:

5, 4, 3, 2, 1, 0, –1, –2, –3, –4, –5,...

15, 12, 9, 6, 3, 0, –3, –6, –9, –12, –15,...

Here –15 is under –5. So 3 . (–5) = –15{remember, 3 times first row give second row} *(This explains 'plus times minus is minus').*

Now repeat the same procedure multiplying 1, 2, 3, 4, 5,... by –3 (we know already that plus times minus is minus):

1, 2, 3, 4, 5

–3,–6, –9, –12, –15

Each number is three units less than the preceding one. Now write the same numbers in the reverse order:

5, 4, 3, 2, 1

–15, –12, –9, –6, –3

and continue the sequence:

5, 4, 3, 2, 1, 0, –1, –2, –3, –4, –5,...

–15,–12, –9, –6, –3, 0, 3, 6, 9, 12, 15,...

Now 15 is under –5; therefore (–3) . (–5) = 15. {This explains minus 3 times minus 5 equals 15}

It is only a teacher with in-depth knowledge of numeral that can provide such explanation and when such knowledge is missing, Mathematics becomes abstract and the teacher a magician. Having identified that numerical ability, or what is termed *subject matter knowledge*, alone is not enough for successful teaching of Mathematics (Silverman and Thompson, 2008), teacher training institution are supposed therefore to give both Subject Matter Knowledge (SMK) and Pedagogical Content Knowledge (PCK) considerable attention. The issue of what types of knowledge are essential for teaching Mathematics in the elementary school has been the subject of numerous conceptual essays and empirical studies for the last 40 years (Mewborn, 2001). Research upholds Dewey's claim that knowledge for teaching is different from knowledge for "doing" in a discipline. Merely "knowing" more mathematics does not ensure that one can teach it in ways that enable students develop the mathematical power and deep conceptual understanding envisioned in current reform documents (For example, National Council of Teachers of Mathematics, 2000).

In many instances, literature shows that teachers are able to successfully perform computations. However, many teachers are unable to provide conceptual explanations for the procedural tasks they perform. For example, a common finding of these studies is that pre-service teachers lack an understanding of quotitive (measurement) division and are prone to rely only on a partitive (sharing) interpretation of division (Ball, 1990; Graeber et al, 1989; Simon, 1993). This becomes particularly problematic in the case of division of fractions where it is almost impossible to make sense of the underlying ideas using a partitive interpretation of division. Many teachers are unable to generate a word problem for a whole number divided by a fraction, often providing a problem that represents a multiplication situation (Borko et al, 1992; Ma, 1999). Teachers tend to rely on their knowledge of whole numbers when working in the domain of rational numbers (Tirosh et al., 1999). This over generalisation from one number system to another leads to misconceptions and impoverished ideas about rational numbers (such as the claim that multiplying two numbers results in a product that is larger than either of the two numbers, a claim that is true for whole numbers but false for rational numbers). Further, many teachers do not know the difference between a ratio and a fraction, believing that because they can be represented with the same notation they behave in identical ways (Fuller, 1997; Leinhardt and Smith, 1985).

Another common finding from literature is that teachers confuse the concepts of area and perimeter (Baturo and Nason, 1996; Fuller, 1997; Heaton, 1992), frequently assuming that there is a constant relationship between area and perimeter. Further, teachers often do not use appropriate units when computing area and perimeter, commonly failing to use square units when reporting measures of area (Baturo and Nason, 1996; Simon and Blume, 1994). The studies cited above lead to the conclusion that many elementary teachers do, in fact, lack a conceptual understanding of the Mathematics they are expected to teach.

The kind of education given to the primary mathematics teachers do not help in grooming them with adequate primary mathematics content. Those courses taken in the Department of Mathematics are beyond what they need and the mathematics methodology courses in the School of Education or Faculty of Education are not wide enough. George Polya, cited by Askey (1999) put this argument in another way: ‘The prospective teacher is badly treated both by the Mathematics Department and by the School of Education. The Mathematics Department offers us tough steak which we cannot chew and the School of Education vapid soup with no meat in it (pg 6).’

What is expected of pre-service primary mathematics teacher, as a knowledge, cut across the three things as classified by Menon (2009):

1. *Traditional,* where teachers rely on their own learning of the subject, and on the tradition of "this is the way it is/was usually done."

2. *Pedagogical,* where teachers modify their teaching of the subject as a result of their experience in working with schoolchildren in the classroom.

3. *Reflective,* where teachers reflect on the actual content of the subject they are teaching, apart from how it is taught.

In a research carried out by Menon (2009), it was discovered that majority of the 64 pre-service teachers that participated in the study seemed to be in the *traditional* phase of subject matter knowledge, where they could do the computations in an algorithmic manner, but were not able to transform that knowledge into either the *pedagogical* phase, or to the reflective phase. This is best shown by their responses to the cylinder problem, when having a deep understanding of mathematics that goes with the reflective phase, would have allowed them to reason out the answer, even without remembering any formula for the volume of a cylinder. Indeed, this was a similar problem posed for middle school children (in http://www.figurethis.org), and these pre-service teachers are supposed to be teaching kids from grades K-8 (equivalent of primary 3 in Nigerian system of education). In their defense, however, it must be stated that they had only completed one mathematics methods course, and were about to take the 2nd mathematics methods course. What is disconcerting, however, is that almost every one of the 64 pre-service teachers had had some college mathematics, and so it is surprising that so many of them were having difficulty with the problem of dividing a whole number by a fraction. One would have expected them to have at least the learnt-knowledge of what they had learnt in school and college, or be in the traditional phase of subject matter knowledge, where they could at least do the procedures. Also, not being able to give a contextualized word problem associated with multiplication and division, is an indication of a not having attained the reflective phase of subject matter knowledge.

One possible way to address this lack of subject matter knowledge, especially the reflective phase, which is so crucial to mathematics teaching, when trying to relate the content to real-life situation, is to give opportunities for the pre-service teachers to reflect on the actual mathematics behind whatever mathematics topics they are supposed to teach. As an example, if students are asked to find all possible (whole number) linear dimensions for rectangles that can be made out of the whole length of a rope of 36 inches long, they could be asked to reflect on the mathematics behind this activity. If they can, for example, be led to see that it reduces to finding two addends whose sum is 18 (such as 1 and 17, 2 and 16, and so on), then we are helping them in the reflective phase of subject matter knowledge. Such knowledge should make them more flexible in their teaching, as they will not only know how to do the computations, but can also see the larger picture of the mathematics on which that computation is based, and can therefore use developmentally appropriate approaches to teach the topic at hand.

In the present day college of education programme in Nigeria, pre-service teacher of primary Mathematics are exposed to only four (4) primary mathematics methodology courses:

Mathematics in PES I (PES 113); Mathematics in PES II (PES 122); Mathematics in PES (PES 222) and Mathematics in PES III (PES 324) (NCCE, 2009). Of these four courses, three (PES 133, PES 122 and PES 324) are meant to expose the pre-service teachers to primary Mathematics content where the emphasis is on traditional knowledge level of subject matter knowledge. It is mandatory that all the pre-service teachers in this department offer these courses because of the "primary school teacher teach all subject" syndrome and the idea of "specialist" is no more in vogue in the public primary school (NCCE, 2009). The implications of this are:

1. Not all these pre-service teachers are up to average student in Mathematics right from secondary school. Many of them hate Mathematics from primary school level but they were forced to take it by the admission requirement. Therefore, such a pre-service teacher lacks the numerical (SMK) ability expected of primary mathematics teachers
2. Now that PES is now double major, that is, students in the department are not meant to take second teaching subject, none of these pre-service primary mathematics teacher could be said to be specialist in Mathematics because none of them takes mathematics courses in the School of Science, Department of Mathematics where they would have gained more knowledge of Mathematics.
3. The common method of teaching, lecture (or modified lecture in some cases), which is teacher centred, cannot equip the pre-service teachers enough SMK that will enable them to change from learner-knowledge to teacher-knowledge or that will give them the pedagogical and reflective level of SMK. All they could gain is the traditional level of SMK as categorized by Menon (2009).

Though, with all said and done, it cannot be claimed that all the pre-service primary mathematics teachers lack numerical ability to handle primary Mathematics. There is always some of the pre-service teachers that are exceptionally good in Mathematics, some are 'averagely good' and while others are below average. The problem is that those that are 'averagely good' and above are always few in the class. Therefore, as literature has shown that SMK, or what is termed *numerical ability* in this study, is paramount to effective teaching of primary Mathematics, it will be important to build it into the study of this nature where the pre-service teachers are being trained through and on the use of activity-based strategies. It will be of interest to see how the numerical ability of the pre-service teachers affects their planning and utilization of activity-based strategies (both the pupil-centred and the teacher demonstration activity-based).

2.2.6 Teachers' Gender and Mathematics Teaching Practices and Learning.

It is imperative to make some clarification between two terms most of the time used interchangeably to refer to the causation of differences between females and males, that is, sex and gender (Fennema, 2000). Research works carried out before 1970 used the phrase *sex differences* when the results were reported. This phrase contributed to the implication that any found differences were biologically and thus genetically, determined (Fennema, 2000). With this, the differences were to be taking as immutable and could not be changed. Therefore, schools could accept the difference as non-changeable and not work to change them. Research findings published during 1970s and 1980s often used the term *sex-related* differences that could be interpreted as behaviour clearly related to the sex of the individual, it was not necessarily genetically determined. More recently, a number of scholars have discussed *gender* differences believing that such a term has a stronger flavour of social or environment causation of differences that are observed between the sexes.

As at today, there are diverse opinions, research findings and submissions about the relationship that exist between gender and learning of Mathematics. One school of thought still believes that gender is a strong determinant of mathematics learning in that male students have higher achievement in Mathematics than female students (Fennema and Sherman, 1977, 1978; Fennema, 2000; James, 2007; Halpern, 2000; David, 2003; Becker, 2003; Gilbert, and Gilbert, 2003; Casey, Nuttall and Pezaris, 2001). Berube and Glanz (2008) reported findings of research works which indicated that no gender difference in the grade and scores in Mathematics at age 9, minimal difference at age 13 but larger difference at age 17 with male having the advantage. It was found out by another separate studies that women represent less than fifteen percent of the employed scientists and engineers in computer science, mathematics, agricultural science, environmental science, chemistry, geology, physics and astronomy, economics, and engineering (NSF, 1996). Females score an average of thirty points lower than males on the mathematics section of the SAT. Despite more than two decades of intervention, parity remains a vision for the future (Becker, 2003). Fennema (2000) submitted that she had worked hard for about 25 years, but in spite of all the works and the additional works done by many dedicated educators, mathematicians, and others, the problem still exists in much the same form that it did in 1974. Not only was she discouraged, she was also convinced a new perspective on the research about women, girls, and Mathematics was needed. Fortunately, she submitted that she was not alone in recognizing that research on gender and education needed to change.

These studies have just shown that at early years there seems to be no difference in the performance of female and male children but at later years, the difference is pronounced. If this is the case, the question then is what brings about the difference at later years in school? Why are there few female mathematicians and scientists in our society? Berube and Glanz (2008) attempted to answer these questions by submitting that girls started performing less because they started losing confidence in Mathematics right from junior secondary school. Hanson (2001) submitted that both heredity and environment are important in shaping mathematical ability. While female brains develop differently, there seems to be some indication that males develop right brain functions earlier than females (Cane and Cane, 1991). An interesting finding in terms of the area of mathematics achievement and gender may surface from recent brain research. It seems that the socialization of young girls may, in fact, interfere with the initial development of brain patterns that enhance mathematics learning. For instance, studies have shown that an enriched environment produces distinct physiological changes within the brain that enhance learning. Thus, if a brain receives repeated stimulation, it develops strengthened neurological pathways enabling faster and more complex processing of information. At the same time, chemical changes within the brain further increase the capacity to process complex information. The more a brain pathway is used, the faster and more permanently does that synaptic activity happens (Hensel, 1989). For girls and for economically disadvantaged children of both genders who are not exposed to Mathematics as play, these neurological pathways may take longer to develop than they would in boys. Equally important from a physiological perspective is the limbic system in the midbrain, which acts as the emotional centre for humans. Although emotional responses are usually viewed from a social perspective, emotions have a biochemical effect on the learning process. This emotional centre can either inhibit or enhance memory and learning, since it combines all experiences of an individual to provide that learner with a frame of reference through which he or she interprets the world. Depending on the affective feelings of the individual as influenced by the environment, this centre can release neurotransmitters that affect the actual learning. If a person experiences joy, the limbic system releases neurotransmitters that increase the speed of learning. Stress, however, activates different neurotransmitters and shuts down the brain's capacity to retrieve or process data (Hensel, 1989). While numerous examples exist of a student's inability to learn a specific process despite repeated attempts by the teacher (often reiterations of the same problem presented in the same way), very little connection has been made with this physiological phenomenon, which says that the student *physically* may not be able to learn at that moment. Should the stress be removed and the problem presented another way, the limbic system can again assist in the learning process. Hanson (2001) here presented inability of female to learn Mathematics as expected as being based on sex, which according to Fennema (2000), should be accepted that way because nothing can be done to change the situation.

Hanson (2001) also explains how some social environmental factors could have been accounting for poor performance of girl child in Mathematics. Throughout their learning, girls are encouraged to be passive, caring, to take no risks, and to defer to male voices in public discussions. They are also given the message that Mathematics is for males. Such an orientation obviously has an impact on how they learn and behave in school. As children grow, they are often unconsciously encouraged to adopt sex stereotyped roles. Boys are encouraged to play with action toys, learning about mathematical concepts. Young girls are encouraged to learn to express themselves verbally, with little opportunity to experience those mathematics concepts (velocity, angles and three-dimensional configurations) that become the core of Mathematics. While still learning language and discourse skills, young boys, as opposed to young girls, learn to be comfortable with a physical world, and to be able to translate that physical world into the discourse of the mathematics class. For boys, Mathematics is not just an abstract concept, it is a firm part of their experiential base, and they can visualize mathematics processes (Hanson, 2001).

Fennema (2000) then suggested that research into gender and Mathematics must continue; that there should be continuity in the monitoring of learning, attitudes, and participation in Mathematics by both sexes. In addition, that there is the need to develop new paradigms of research that will provide insight into why gender differences occur. In other words, gender as a critical variable must enter the mainstream of mathematics education research. Becker (2003) supports this by saying that traditional ways of teaching Mathematics-stressing certainty, a single correct answer, deduction, logic, argumentation, algorithms, structure, and formality- may be particularly incompatible with the ways in which many females learn. Researchers have hypothesized that a different learning style, described in Women's Ways of Knowing (Belenky et al., 1997), explains why females avoid Mathematics and related careers. In this theoretical model of how women "come to know," the authors present five perspectives: silence, received knowing, subjective knowing, procedural knowing (separate and connected), and constructed knowing.

In the silence perspective, knowledge does not belong to the individual and usually is not vocalized; the learner accepts the judgment of an authority-for example, the teacher-for what is true. In the received-knowing perspective, the student learns only by listening and returns the words of the authority figure. The learner's knowledge is dependent on an external source, and the learner is content to accept the knowledge that is presented. For example, when asked why one inverts and multiplies to divide fractions, a learner in this perspective might say, "Because my teacher told me to do it that way." In the subjective-knowing perspective, knowledge develops from one's own experience. The learner depends on what looks or feels right, rather than merely what an external source has said.

In the procedural-knowing perspective, the voice of reason emerges and the learner begins to evaluate the validity of arguments. Belenky and her colleagues identified a gender difference in this perspective: Men seem to favour logic, argumentation, and rigor to evaluate validity, or separate knowing (Perry, 1970), whereas women are more likely to use conjecture and their own and others' experience and knowledge, or connected knowing. Authority comes from these shared experiences. In the constructed-knowing perspective, one integrates intuitive knowledge with that derived from experience and what others know. The learner appreciates the complexity of knowledge and the importance of context.

This theory has classroom implications as discussed below:

Although Women's Ways of Knowing was developed from extensive research with older learners, we can glean from this theory some important implications for teaching Mathematics in the primary school level. Instruction should stress connected teaching of Mathematics in which the elements address issues such as:

Voice: The first important element is voice. Considerable research has documented that girls usually are the listeners in the classroom, are relegated to a less active role, and interact less frequently and in a less challenging way with teachers (American Association of University Women, 1992). Girls must develop their own voices in the classroom and all students must develop their own sense of authority, instead of relying on the teacher as the source of answers. Class discussions, group problem solving, and students' presentations of different solution strategies can help students communicate their thinking. Students also can develop their voices through writing exercises that focus on what they have learnt.

Firsthand Experience: Firsthand experience can help students construct their own understanding and build on intuition. Active involvement in classroom activities also discourages passive acceptance of knowledge. Students can draw figures and construct models, use technology, collect and analyze their own data, and develop and test conjectures.

Confirmation of Self as Knower: Girls need confirmation that they are knowers and doers of Mathematics. Students must understand more than rules or algorithms and be involved in the development of their own rules. They should build new knowledge on what they already understand. Teachers who reduce the amount of teacher talk will not only open up time for student talk but also change their role from a teacher to a facilitator who listens and questions in order to elicit students' ideas and reasons.

Problem Posing: Students can pose their own problems in a classroom that values extensions and new questions that might arise by changing one or more conditions in the original problem.

James (2007) examined the difference between male and female learners from the angle of their reactions to mathematics problems, dyscalculia, which is to mathematics as dyslexia is to reading and language arts, and it has a wide variation in severity. As mentioned before, dyscalculia seems to affect men and women equally, but their responses to the learning disability differ greatly. In elementary and secondary schools, girls with this disorder will give up because Mathematics is too hard, arguing that, besides, they are not supposed to do well in the subject anyway. Boys with the disorder will frequently sabotage themselves by failing to write down their homework assignment or losing their homework so that the teacher will not know that they cannot do mathematics (James, 2007). In post-secondary education, the student with severe dyscalculia will try to get out of any mathematics requirement or will take a practical mathematics such as bookkeeping. However, there are students with mild dyscalculia who benefit from knowing that their mistakes are not careless, but due to a learning disability. Once they are aware of this, they are usually much more willing to go ahead in the subject even though they may continue to make simple mistakes.

There seems a promising reports from AAUW 1995 as reported by Berube and Glanz (2008) that the gap between male and female children is diminishing and that this gap can be successfully eradicated by using better teaching methods; the gender difference is not consistent across racial and ethnics differences so the difference in mathematics is not gene-based. Many scholars have been trying to proffer solution to this problem so as to bring about gender equity into mathematics classroom. To this end, Levi (2000) interviewed elementary school teachers about how they addressed the problem of gender equity in mathematics education. She highlighted three roles that teachers should play, namely, (a) ensure provision of equal opportunities and respect for differences in the classroom, (b) ensure that boys and girls have the same experience, that is, treat boys and girls equally, and (c) compensate for gender differences in society. It has also been suggested that constructivist teaching could alter the imbalance in the mathematics classroom (Berube and Glanz, 2008).

Another school of thought is of the opinion that the gap between male and female in mathematics learning is no more significant (Spencer, Steel and Quinn, 1999; Austin, 2002; Berube and Glanz, 2008). David (2003) reported that gender differences in achievement have disappeared in Israel in all educational levels. In addition, in many fields and areas, considered as "masculine" all over the world, the majority of students in Israel were females. While among males 23% of the examinees took the highest-level 5-point mathematics examinations and among girls only about 14%, 43% of those succeeding in this examination in the Jewish sector were girls. In the Arab sector the female percentage was 47. When combining the number of girls who succeeded in the 4-point level, still satisfying the entrance requirements of higher education institutions in Israel, with those successful in the 5-point level mathematics examination, Arab girls outperformed boys. In the Jewish sector the difference was negligible; two years later Jewish girls already were the majority among those taking the 4- and 5-point mathematics examination. In addition, in the Arab sector the percentage of girls taking the highest-level physics examination was double that of boys. The gender issue in learning Mathematics is not considered the most crucial one in learning Mathematics in Israel.

Conclusion on this issue is varied and depends on the context, which makes it inconclusive. A study carried out by Arigbabu and Mji (2004) on academic performance of pre-service teachers over three academic sessions reveals that overall, there is no significant difference between the scores of male and female students in Mathematics. Though male students do have higher mean scores over the three years but the difference is shown not to be statistically significant. Spencer, Steele and Quinn (1999) carried out three studies that show that stereotype threat is also a major cause of underperforming of women in Mathematics. In Study 1 they demonstrated that the pattern observed in the literature that women underperform on difficult (but not easy) mathematics tests was observed among a highly selected sample of men and women. In Study 2, they demonstrated that this difference in performance could be eliminated when they lowered stereotype threat by describing the test as not producing gender differences. However, when the test was described as producing gender differences and stereotype threat was high, women performed substantially worse than equally qualified men did.

However, much effort has been spent on gender and mathematics learning but little has been done on the influence of teacher's gender on mathematics teaching. A few studies have shown that teacher gender significantly influences students' achievement in Mathematics (Klees, 1979; Saha, 1983; Mwamwenda and Mwamwenda, 1989). Wong and Lai (2006) found in a research conducted that female student-teachers taught better than male student-teachers. The 2-phased study also indicated that female student-teachers' instructional strategies were more creative and well designed than male student-teachers. This finding has a serious implication for mathematics education in that it tries to explain that even when male possesses subject matter knowledge than female, females are better in mathematics pedagogical knowledge. If female are better teachers of mathematics but they are unable to learn enough mathematics to become teachers because of either generic or socio-environmental issues, then more research work are called for. But the major concern now relates to how to carry out more research work on effect of gender on effective teaching which informed the introduction of gender as one of the moderator variables in this study.

Also, it has been reported that teacher gender has a stronger influence on students' mathematics achievement than does by student gender (Warwich and Jatoi, 1994). Pre-service teachers are indeed tomorrow's educational leaders. As in other parts of the world, very few studies have been done on gender differences *vis-`a-vis* mathematics performance among pre-service teachers in Nigeria (Arigbabu and Mji, 2004). This being a difficult issue in education, it is important to know if female teachers cannot plan and teach Mathematics effectively like their male counterparts. It is necessary that any introduction of resource or strategy be tested for gender equality to ensure that no group of students (or pre-service teachers) is left out.

2.2.7 Appraisal of Literature Review

The history of teaching was traced from the time teachers received no training to the time when anyone with formal education is expected to be a teacher up to the present time when anyone without teaching qualification is asked out of the teaching profession. It is quite evident that the quality of teachers is directly related to the quality of educational system where these teachers work. Therefore, if the standard of educational system of a given nation is to be improved, or ineffective learning of a particular area of study is noticed, such could be addressed by improving the teacher education of such educational system.

It has been established that Nigerian students are not performing well in Mathematics and many of them are running away from studying the subject at higher institutions. This problem has been traced to ineffective way of learning the subject at the lower level of their education, at the primary school level to be precise. An examination of the training received by the primary mathematics teachers reveals that they were taught with teacher-centred methods of teaching while in training. This does not allow hands-on, mind-on, activity-based, learn-to-do-it-by-doing-it method and they were not opportune to see the lecturers present an activity-based lecture where primary mathematics concepts are related to real-life situations/problems. Since one can only teach the way one was taught, these teachers also teach primary Mathematics using teacher-centred methods. This method, teacher-centred, has been found to be ineffective in teaching the subject. This must be responsible for why pupils dislike the subject, performing below expectation in it and many of them do not like to study it in the higher institutions.

Individual scholars, government agencies and non-governmental organizations have observed this problem and have been trying to proffer solutions to it through research studies, workshops seminars and trainings. It has been observed, however, that it seems there is dearth of information about effort made to train pre-service teachers in Nigeria on how to plan and deliver activity-based primary mathematics lessons. This has to be addressed quickly because:

- Mathematics at early stage of education (pre-primary and primary school) has to be directly related to real-life situations/problems through various activities in order to make it meaningful.
- For a teacher to be able to plan, deliver and evaluate activity-based lesson, such a teacher must have been put through how to do it by hands-on/mind-on methods; he/she must have observed, on many occasions, the presentation of his/her lecturers using such methods.
- Teacher-centred methods of teaching primary Mathematics makes the subject highly abstract, meaningless and boring; while activity-based teaching strategy demystifies the teaching and learning of the subject.
- Primary mathematics teachers produced by the Colleges of Education in Nigeria teach using teacher-centred method of teaching because that is the way they were taught.
- Mathematics, the bed rock of the sciences, is an important subject that cannot be taught at primary school like other subjects such as languages, social sciences and humanities, hence, primary mathematics teachers must be well trained.

CHAPTER THREE

METHODOLOGY

This chapter presents the research method used in carrying out this study. The following are discussed in the chapter: research design, selection of participants, research instruments, validation and reliability of the instruments, research procedure and method of data analysis.

3.1 Research Design

The study adopted a pretest-posttest, control group quasi-experimental research design for the phase I of the study while causal-comparative research design of the ex-post facto type was used for the phase II. Quasi-experimental research is described as the type of experimental research that is carried out in socio-scientific situation wherein the independent variable(s) cannot be totally controlled (Isangedighi 2004). Kerlinger and Lee (2000) submits that quasi-experimental, also known as compromise design, is the type of experimental design that fails to satisfy one or all the following conditions: (i) manipulation of one or more independent variable(s); (ii) random assignment of the participants into groups and (iii) the random assignment of groups to treatment. The study at hand is about real life teaching/learning situations in the colleges of education and one of these prerequisite conditions (assignment of participants to groups) could not be satisfied, hence the choice of quasi-experimental research design.

Pretest-posttest, control group design is the type of quasi-experimental design in which the behaviour of the participants in the research is measured before and after the treatment in both the experimental and the control groups. This study is also interested in the entry behaviour as well as post treatment behaviour of the participants. The entry behaviour will be used for two things: (a) to verify if the groups are almost the same or significantly different in their knowledge about planning an activity-based lesson before treatment and (b) to determine the extent to which the participants are knowledgeable about the content before and the shift in their knowledge after training. At the end, that it may be justified that the post behaviour of the pre-service students on pupil-centred ABL as well as TDL are the results of the training, there must be a control group. In addition, that the design will not fall into the category termed *faulty design* by Kerlinger and Lee (2000). Based on all these, the design, pretest- posttest, control group quasi-experimental is considered the best for the phase I of this study.

Phase II of this study has to do with the examination of the impact of the training received by the pre-service teachers on their teaching practices. The causal-comparative research design of the ex-post facto type was adopted to carry out this phase. This design is considered appropriate because all that was done was tailored towards the observation of the trained pre-service teachers during their teaching practice exercise in order to determine whether or not the training they had received have impact on their teaching practices. The influences of already existing moderator variables - numerical ability and the gender of the pre-service teachers, on the activity-based lesson delivery were also examined.

Variables of the study:

Three categories of variables are recognised in the study. These are: independent variable, moderator variables and dependent variables. These variables are discussed below.

Independent variable;

This is the teaching strategy to be used in the preparation of the pre-service primary school mathematics teachers. This was manipulated at three levels:

(i) Pupil-centred Activity-Based Instructional Strategy (PABI)

(ii) Teacher Demonstration Activity-Based Strategy (TDAS) and

(iii) Conventional Instructional Strategy (CIS)

Moderator Variables;

These are two traits inherent in the pre-service teachers that could influence their teaching as well as their job performance; these are

(i) Numerical ability of the pre-service teachers. This is measured at three levels (low, average and high).

(ii) Pre-service teacher's gender. This is at two levels (male and female).

Dependent Variables:

There are two dependent variables in this study, each at different phase of the study. These are:

a) Activity-based lesson planning skills (For Phase I) and

b) Utilization of activity-based lesson (For Phase II)

Based on the variables identified above, the study made use of 3 X 3 X 2 factorial matrix design for the Phase I of the study. This is schematically presented below:

Table 3.1: A 3 x 3 x 2 Factorial Design

TREATMENT	NUMERICAL ABILITY	TEACHERS' GENDER	
		MALE	FEMALE
PUPIL-CENTRED ACTIVITY- BASED STRATEGY	LOW		
	AVERAGE		
	HIGH		
TEACHERS DEM. ACTIVITY STRATEGY	LOW		
	AVERAGE		
	HIGH		
CONVENTIONAL STRATEGY	LOW		
	AVERAGE		

	HIGH		

3.2 Selection of Participants

The target population for this study consists of the students studying Primary Education Studies (PES) in Part One of their programme in Colleges of Education in south-western part of Nigeria. This category of students is the potential mathematics teachers that are to expose the pupils to Mathematics and sciences in the nearest future. The one hundred level students, in second semester, are purposively selected based on some conditions: (i) these students must have been exposed to various teaching strategies in EDUC 113 (Principles and Methods of Teaching) and also some primary mathematics contents in the college in PES 113 (Mathematics in Primary Education Studies 1). (ii) Because of the teaching observation that is involved in this study, the students must have been exposed to treatment before the Micro Teaching Theory (EDUC 213) which comes up in the first semester of second year.

Multi-stage sampling technique was used to select the participants for the study. First, simple random sampling technique was used to select three Colleges of Education in the south west zone states (Federal and State inclusive). Both Federal and State colleges were sampled because they both operate same standard and curriculum provided by NCCE. Besides, teachers from these types of colleges are employed to teach in the government-owned primary schools without any discrimination. Stratified random sampling was used to ensure that each of the state in south west of the country is involved and the only criterion for their selection was the availability of Primary Education Studies (PES) in the college of education located in the state. Where there was more than a college that satisfies this condition in a given state, simple random sampling was then used to select one of them. Purposive sampling technique was used to select the students that participated in each of the colleges. The selection of students was based on the following criteria:

1) The students must be in their first year of the NCE programme;
2) The students must be in Primary Education Studies (PES) Department.

In all, three Colleges of Education that have PES programme were involved in the study and all the PES students in their first year in each of the colleges were involved. The study targeted an average of 80 students per College which totalled 240 students in 100 level of NCE programme.

But at the end of the selection, 73, 103 and 161 students participated in Federal College of Education, Osiele Abeokuta, Ogun state; Adeniran Ogunsanya College of Education Ijanikin Lagos State and Federal College of Education Oyo, Oyo State respectively. The three colleges were randomly assigned to treatment groups (a college in a treatment group).

3.3 Research Instruments

The following research instruments were developed, validated and used for data collection for this study:

1. Activity-Based Lesson Plan Format (ABLPF)
2. Pre-Service Teachers Activity-Based Lesson Plan Scale (PSTABLPS);
3. Activity-Based Lesson Utilization Scale (ABLUS);
4. Attitude Towards Activity-Based Lessons Questionnaire (ATABLQ)
5. Primary Numerical Ability Test (PNAT)
6. Pupil-centred Activity-Based Instructional Package (PABIP)
7. Pupil-centred Activity-Based Instructional Package Validation Tool (PABIPVT)
8. Teacher Demonstration Instructional Package (TDIP) and
9. Conventional Strategy Instructional Guide (CSIG)

3.3.1 Activity-Based Lesson Plan Format (ABLPF)

This instrument was adapted from the Activity Planning format (Produced in Nipissing University). It was used to train the pre-service teachers on how to develop activity-based lesson. It has six stages, viz: (i) general information which includes: subject area, class, topic, sub-topic, time, period and duration (ii) Pre-assessment stage which includes: entry behaviour, existing learning environment and available resources/materials (iii) Behavioural objectives which should cover the learning domains (iv) classroom activities for both pupils and teachers (v) Assessment which includes tools for assessment and assessment items and (vi) Teacher's reflection on the lesson which includes: achievement or otherwise of objectives, effectiveness of teacher's activities and next step of actions.

Validation of ABLPF

ABLPF was subjected to criticism by lecturers in the Department of Teacher Education and their comments were used to produce the final version.

3.3.2 Pre-Service Teachers Activity-Based Lesson Plan Scale (PSTABLPS)

This was a self- designed instrument that tries to measure the pre-service teachers' skills in (a) stating behavioural objectives for ABL (b) selection/designing of appropriate materials (c) Planning pupils/teachers activities and (d) Identifying/designing assessment tools. The design of this instrument was tailored towards the adapted pre-service lesson plan format and it was used as a standard to measure the lesson plan at the pre and post level of the study.

The instrument has 5 parts. Part 1 deals with demographic data of the students. There was no mark allotted to this part; part 2 measures the knowledge and skills in stating behavioural objectives for ABL. The items under this part cover (i) coverage of learning domains (ii) qualities of good behavioural objective, such as, being stated in measurable terms, condition of demonstration, taking care of average learners in the class and so on and (iii) appropriateness of the objectives to the topic at hand. The total mark allotted to this part is 25 marks. Part 3 deals with skills of identifying/designing/improvising instructional materials that is developmentally appropriate to the pupils as well as the topic at hand. Items here cover (i) appropriateness of the materials to convey mathematical concept to be discussed (ii) age appropriateness and individual appropriateness of the materials (iii) availability/access to the materials by the pupils and the teachers (iv) provision; ready-made or improvised; the cost and number of mathematics ideas it could be used for. 25 marks were allotted to this part too. Part 4 deals with designing of both pupils' and teachers' activities. Items in this part cover (i) activity must have mathematical ideas embedded in it, (ii) logical presentation of activities, (iii) time/space consideration, (iv) level of involvement-individual, group or selected members of the class. 25 marks were allotted to this part too. Part 5 deals with the skills in identifying/designing of assessment tools for ABL. Items under this cover (i) appropriateness of instrument (ii) validity of instrument (iii) mark allocation (iv) consideration for intellectual, social and physical activities. 25 marks were allotted to this part.

The total score a candidate could obtain in a planned lesson, using this tool to measure it, is 100 marks.

Validation and Reliability of PSTABLPS

The instrument was subjected to constructive criticism in the Department of Teacher Education and Institute of Education. The supervisor of this study was also consulted to this effect. The corrections from the various experts were used to produce the final copy and reliability was determined using inter-ratter technique. Correlation coefficient r = 0.837 was obtained using Spearman Correlation.

3.3.3 Activity-Based Lesson Utilization Scale (ABLUS)

This instrument was adapted from the Department of Teacher Education. It is the instrument used to assess the teaching performance of education students during Teaching Practice and it is titled "Teaching Performance Assessment Sheet". It was used in this study to rate the teaching skills particularly in presenting an activity based mathematical lesson by the pre-service teachers. Some adjustments were made to the original instrument. The adapted version of the instrument focuses on the following areas: (a) ability to make the pupils ready by examining their entry behaviour and building the new lesson on their entry behaviour; (b) presenting the pupils' and teacher's hand-on activities; (c) observing pupil's individual participation and guiding their learning while on activity (d) using and allowing questioning method that will enhance the pupils' learning. The instrument was adjusted such that it contains 20 items instead of 19 in the original format.

Validation and Reliability of ABLUS

Experts, senior lecturers in the Department of Teacher Education as well as veterans in primary Mathematics were consulted for the validation of the instrument, and the reliability coefficient was calculated using inter-ratter technique. The correlation coefficient r = 0.793 was obtained.

3.3.4 Attitude towards Activity-Based Lesson Questionnaire (ATABLQ)

This questionnaire was a self-designed instrument that tends to measure the pre-service teachers' perceptions about activity-based lesson. The instrument comprises three (3) parts - Part A, B and C. Part A measures the demographic data of the pre-service teachers. There are three items in this part: the gender, institution and the teaching subject of the pre-service teachers. Part B measures the perception of the pre-service teachers about activity-based lesson. There are 15 items in this part which is on 4-point likert scale. The part also comprises 10 positive and 5 negative items. Part C consists of two (2) open-ended items. The first item explores the difficulties faced by the pre-service teachers during the process of planning activity-based lessons. The respondents were expected to supply three points here. The second item seeks the pre-service teachers to supply three difficulties they faced during the process of using activity-based strategy to teach. It is also an open-ended item. In all, there are 20 items in ATABLQ.

Validation and Reliability of ATABLQ

This instrument was validated by lecturers in the Department of Guidance and Counselling and Teacher Education. Some of the items were re-structured and the final copy was presented to the supervisor of the researcher for final approval. Twenty (20) copies of the final version was produced and administered to pre-service teachers in Adeyemi College of Education, Ondo. These were used to test for the reliability using Cronbach Alpha and the coefficient obtained was 0.81

3.3.5 Primary Numerical Ability Test (PNAT)

This is a self-designed instrument which is meant to measure the pre-service teacher's primary numerical ability. It contains 20 items which cut across five (5) major topics in primary Mathematics, namely: Number and Numeration, Basic Operations in Mathematics, Measurement, Practical and Descriptive Geometry and Everyday Statistics. All the questions are multiple choice types with one correct answer and three distractions (A to D). Table 3.2 shows the specification of the items in the instrument.

Table 3.2: Table of Specification for PNAT

S/N	Topic	Knowldg.	Comp.	Appl.	Analy.	Synth.	Eval.	Total
1	Number and Numeration		Q1	Q2	Q3			3
2	Basic Operation	Q7, Q8	Q9	Q4	Q6, Q10		Q5	7
3	Measurement			Q11, Q13		Q12		3
4	Geometry		Q17	Q16			Q14, Q15	4
5	Everyday Statistics	Q18, Q19, Q20						3
	Total	5	3	5	3	1	3	20

Table 3.2 shows that out of the 20 items in the instrument, 3 were drawn from number and numeration; 7 from basic operations; 3 from measurement; 4 from geometry and 3 from everyday statistics. It also shows that 13 of the questions spread over the lower level of cognitive learning domain and 7 are on upper level of cognitive learning domain. The performance of the pre-service teachers in this test was used to categorise them into three numerical ability levels, namely: low, average and high primary numerical ability.

Validation and Reliability of PNAT

The instrument was presented to lecturers in the Institute of Education and those in the Department of Teacher Education, University of Ibadan for criticism. Their suggestions were used to produce the final copy which was shown to the research supervisor for final approval. The approved version was field tested and the completed ones (20 copies) were used to test for its reliability using Kudar Richardson formula 20 (KR20) and it yielded a reliability coefficient of 0.83.

3.3.6 Pupil-Centred Activity-Based Instructional Package (PABIP)

This stimulus instrument was the most important in this study. It was designed by the researcher and it consists of the guide on the activity-based instructional strategy as well as the package to be delivered. This was used to prepare the pre-service teachers in the experimental groups. The instrument covers all topics in PES 122 (Mathematics in Primary Education Studies 11). The choice of this course is informed by the following reasons: (i) the course contents are basically on primary mathematics topics and it is offered during the second semester of the 100 level (ii) it is the only primary Mathematics course in the second semester of the 100 level that the pre-service teachers would be prepared with, for the upcoming Micro Teaching Practicum (in EDUC 224). For every topic selected, the instrument covers how to perform the following: (a) state the behavioural objectives (b) selection of instructional and manipulative materials; (c) identifying both pupils' and teacher's activities; (d) presentation of the planned ABL; (e) evaluation of the whole teaching/learning process. This package also features several worksheets which give and guide the students on various activities they are expected to carry out. It is worth emphasizing that at every stage of the preparation as identified above, the pre-service teachers will be taken through learn-to-do-it-by-doing-it (activity-based) strategy using Activity Planning Format (APF).

Validation of PABIP

The validation of this instrument called for another instrument named **Activity-Based Instructional Package Validation Tool (ABIPVT)**. It is a 19 item instrument self-designed by the researcher. The first two items seek the name of the assessor and the number of the lecture to be assessed; the next 16 items cover all the other aspects of PABIP with response ranging from adequacy or otherwise, appropriate or otherwise and comments about each item; the last item was the general comment on the particular lecture assessed. Ten (10) of this instrument were given to each assessor alongside PABIP for the validation process. The responses of the assessors were used to make correction on PABIP. The supervisor of this study gave the final approval for both PABIP and ABIPVT.

There are two important stages in every mathematics lesson in the primary school; the first stage is when the teacher introduces the new mathematics skill(s) and the second is when the pupils are allowed to practice the newly acquired skill(s). The first stage is, most of the time, teacher-centred, and the pupils are left passive or, at best, left to copy notes. The second stage involves the active participation of the pupils when they are allowed to do some mathematical (paper/pencil) exercises following the steps taught by the teacher. Any mathematics lesson that engages pupils in only the second stage is not recognised as being activity-based in this study, but a lesson is said to be activity-based if and only if the pupils are actively involved in the first stage.

The types of activity that can take place in the first stage of mathematics lesson in the primary school are of two forms. The first form is known as manipulation and it entails making the pupils to interact with materials or create a real life situation which would expose the first-hand knowledge of the mathematics skills to be taught. The other form is paper-pencil exercises with teacher directed to expose the pupils to new mathematical knowledge. The choice of the form of activity to be employed strictly depends on the mathematics topic. In this study, the first form of activities (manipulation of materials) was the focus.

3.3.7 Teacher Demonstration Instructional Package (TDIP)

This instrument, TDIP, is similar to ABIP in some respect. It contains the course content of PES 122, the activity-based lesson format and the lesson plan for each lecture. The activities are included but, this time, they are to be carried out by the lecturer. Hence, in the lesson plan, the activities are written under the teacher's activity. The worksheets were also excluded in this package since the pre-service teachers exposed to this strategy will not be using them.

Validation of TDIP

This instrument was also validated by lecturers in the Department of Teacher Education, Institute of Education and experienced primary mathematics teachers. These experts looked into the face and the content validity of this stimulus package. Their corrections were effected and were submitted to the supervisor for final approval.

3.3.8 Conventional Strategy Instructional Guide (CSIG)

The development of this guide was informed by the realization that there are various types of conventional strategies, including what is commonly referred to as the purely chalk and talk, and the slightly modified forms. The guide was designed by the researcher to ensure that the conventional strategy used in delivering the lessons in the control group was not too modified. The guide was a set of steps involved in the presentation of the lesson in the control group. The following steps were followed:

- Presentation of the course content by the lecturer
- Lectures are held without teaching aids and students are just to take notes and ask questions
- Examples, illustrations and further explanations are done using chalk and talk methods
- At the end, a short test was given (possibly the post-test measure).

All the content of PES 122 (Mathematics in Primary Education Studies 11) was broken down to the number of weeks for the course.

Validation of CSIG

The CSIG was validated by experienced lecturers in some Colleges of Education in Nigeria as well as educational research experts in the Faculty of Education, University of Ibadan. Their corrections as well as that of the supervisor were effected before the final copy was produced.

3.4. Procedure

The first phase of the study was planned to cover the whole semester, which was fifteen (15) weeks, while the second phase was just three (3) weeks. The plan of the activities was as described below:

3.4.1 Training of the Research Assistants

A training programme was organized for the research assistants that participated in this study. These research assistants are the lecturers teaching PES 122 in the selected colleges, hence they were automatically selected. The training was to acquaint the lecturers with the respective strategies they were expected to use (either pupil-centred activity-based, teacher demonstration or the conventional) and the strategy guides was made available for the research assistants after the training. The training was conducted separately in the three colleges selected for the study and it lasted for a week as shown below:

First Week:

(Experimental Group I)

- **Monday:** Meeting the lecturer and the introduction of Activity-Based Lesson Plan Format and how to use it. Examination of the lessons and the worksheets; reactions from the lecturer.
- **Tuesday:** Demonstration of the mastery of the strategy; necessary corrections made.

(Experimental Group II)

- **Wednesday:** Meeting the lecturer and the introduction of Teacher Demonstration Lesson Plan Format and how to use it. Examination of the lessons and the worksheets; reactions from the lecturer.
- **Thursday:** Demonstration of the mastery of the strategy; necessary corrections made.

(Control Group I)

- **Friday:** Meeting the lecturer and discussion on the type of conventional strategy required of the research; Demonstration of the mastery of the conventional strategy.

3.4.2 Treatment Stage (Experimental Groups)

This is the stage where the research participants were given the necessary treatments after the administration of pre-tests. It is worth emphasising here that the treatment was in the form of normal classroom teaching but activity-based strategies were used to expose the participants in the experimental groups to PES 122 and the researcher was available in most of the classes in these groups. This procedure is presented in the steps below:

- **First Week:** Administration of the pre-test observations as well as the numerical ability test; introduction of activity-based lesson plan format to the participants.
- **Second Week:** Lecture on modelling and drawing plane shapes; method of teaching it at primary school.
- **Third Week:** Lecture Modelling 3D shapes and methods of teaching it at primary school.
- **Fourth Week:** Administration of Attitude towards Activity-Based Lesson Questionnaire**;** Lecture on construction and bisection of angles.
- **Fifth Week:** Lecture on non-standardised and standardised measurement of length and perimeter
- **Sixth Week:** Lecture on area
- **Seventh week:** Lecture on volume and capacity of solid shapes
- **Eight Week:** Lecture on Weight, Money and Time
- **Ninth Week:** Post test on planning an activity-based lesson

Control Groups

- **First Week:** Administration of the pre-test observations as well as the maths ability test.
- **Second Week:** Lecture (conventional) on modelling and drawing plane shapes.
- **Third Week:** Lecture (conventional) Modelling 3D shapes
- **Fourth Week:** Lecture (conventional) on construction and bisection of angles.
- **Fifth Week:** Lecture (conventional) on non-standardised and standardised measurement of length and perimeter
- **Sixth Week:** Lecture (conventional) on area
- **Seventh week:** Lecture (conventional) on volume and capacity of solid shapes
- **Eight Week:** Lecture (conventional) on Weight, Money and Time,

- **Ninth Week:** Post test on planning an activity-based lesson

3.4.3 Field Observation Stage (Phase II)

During the Micro Teaching Theory (EDUC 213), which came up in the first semester of the following session, all the participants exposed to various treatments were observed using Pre-service Teacher Lesson Presentation Scale twice;

- First Observation was in the second week of the Practicum. After the first observation, corrections were made where necessary.
- Second observation was conducted in the third week of the practicum.

3.4.4 Summary and Time Schedule of Procedure

Training of research assistants……………….... 1 weeks

Pre-test observations…………………………… 1 week

Treatment delivery……………………………... 8 weeks

Post-test observation…………………………… 1 week

Sub-total ………… 11 weeks

Field observation ……………………………… 3 weeks

Total ……………… 15 weeks

3.5 Method of Data Analysis

Both descriptive and inferential statistics were used to analyse data collected in this study. Descriptive statistics of frequency count, percentages and graph were used to analyse the demographic data; these, in conjunction with Mean and Standard Deviation were used to answer the research questions as appropriate. Inferential statistics of Analysis of Covariance (ANCOVA) and Factorial Analysis of Variance (ANOVA) were used to test the null hypotheses; Estimated Marginal Means was used to evaluate the magnitude of performance in each group. Scheffe's Post Hoc test (pair-wise comparison) was used to reveal the source(s) of any significant difference among groups that are more than two. The hypotheses were tested at 0.05 level of significance.

CHAPTER FOUR

RESULTS

This analysis is based on the number of participants that fully participated in this study from the beginning to the end. Of the pre-service teachers exposed to Teacher Demonstration Strategy (TDS), Pupils-centred Activity-based Instructional Strategy (PABIS) and Conventional Strategies, only 161, 103 and 73 respectively fully participated in the study at the phase-1 stage and 101, 72 and 143 pre-service teachers respectively participated in the phase-2 stage.

4.1--- Demographic Data Analysis

Table 4.1.1: Distribution of the Pre-service Teachers Based on Numerical Ability and Treatment groups

TREATMENT	NUMERICAL ABILITY			TOTAL
	LOW	AVERAGE	HIGH	
TDAS	65	28	10	103 (30.6%)
PABIS	38	25	10	73 (21.7%)
CONV.	97	37	27	161 (47.8)
TOTAL	200 (59.3%)	90 (26.7%)	47 (13.9%)	337

Table 4.1.1 reveals that out of the 337 pre-service teachers involved in this study, 59.3% had low numerical ability; 26.7% were average and only 14% had a high numerical ability. It is also revealed in the table that 30.6% of the students were exposed to Teacher Demonstration Strategy (TDS), 21.7% were exposed to Pupils-centred Activity-based Instructional Strategy

(PABIS) and 47.8% were exposed to Conventional Strategy. Figure 4.1.1 is a depiction of this information in a chart.

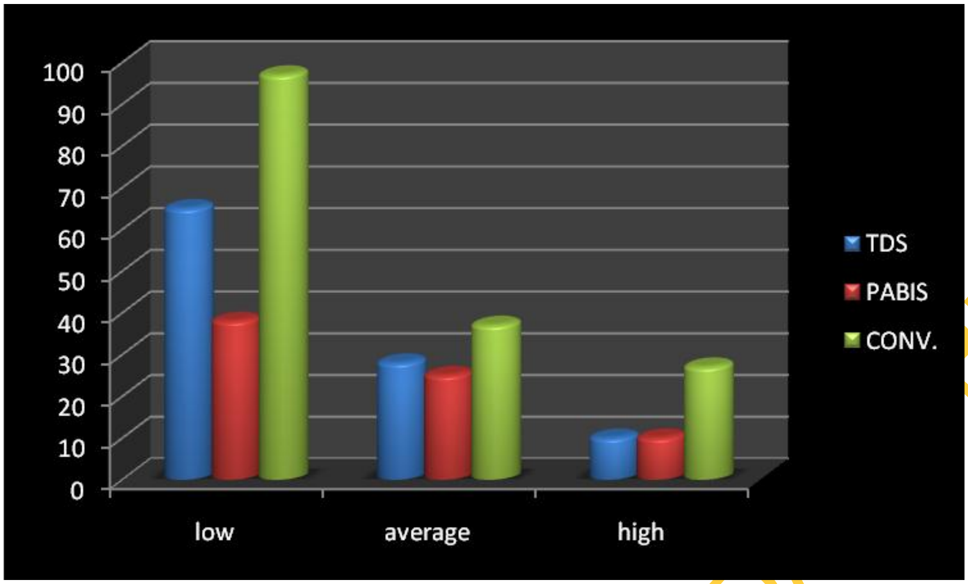


Fig.4.1.1: Bar Chart Showing Distribution of the Pre-service Teachers Based on Their Numerical Ability and Treatment Group

Table 4.1.2 presents the cross tabulation of the treatment groups and the gender.

Table 4.1.2: Distribution of the Pre-service Teachers Based on Gender and Treatment groups

TREATMENT	GENDER		TOTAL
	MALE	FEMALE	
TDS	26	77	103 (30.6%)
PABIS	18	55	73 (21.7%)
CONV.	67	94	161 (47.8)
TOTAL	111 (32.9%)	226 (67.1%)	337

Table 4.1.2 shows that majority of the pre-service teachers are female 67.1% while only 32.9% of them are male. Of the total number of male, 34.4% were in the TDS groups; 16.2% were exposed to PABIS and 60.4% were exposed to conventional strategy. Of the total number of female, 30.1% were exposed to TDS; 24.3% were exposed to PABIS and 41.6% were exposed to conventional strategy. This shows that both sexes participated in the study. Figure 4.1.2 is a depiction of this information in a chart.

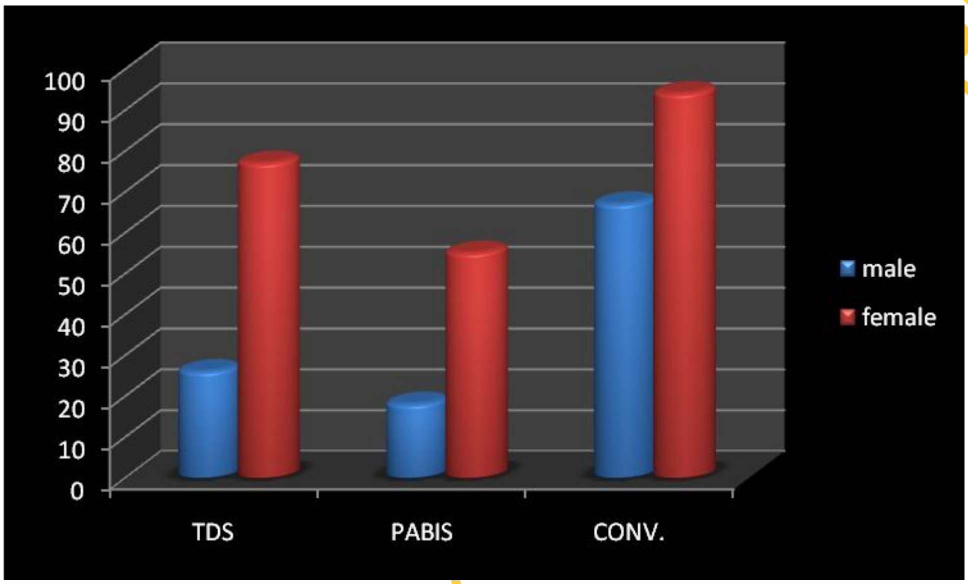


Fig. 4.1.2: Bar Chart Show Gender Distribution of the Pre-Service Teachers

4.2 : Answers to the Research Questions (RQs)

RQ1: What is the perception of the pre-service teachers exposed to training programmes about pupil-centred activity-based and teacher demonstration instructional strategies?

Questionnaire titled "Attitude towards Activity-based Questionnaire" was administered to the pre-service teachers in the experimental groups (Those in Activity-based and Teacher Demonstration Groups). Their responses are presented in table 4.2.1.

Table 4.2.1: Perceptions of the Pre-service Teachers about Activity-Based Teaching

S/N	STATEMENT	SD	D	A	SA	MEAN	STD. D
1	Teaching primary maths using activity-based strategy will bring about meaningful learning.	6	5	79	86	3.39	.71
2	The foundation for in-depth understanding of maths at secondary and higher institutions could only be built with activity-based lessons at primary school.	14	43	76	41	2.80	.93
3	I prefer activity-based maths lesson to teacher-centred lesson	5	13	92	65	3.22	.75
4	I understand many maths concept better with activities than when I was taught through teacher-centred	15	24	62	69	2.98	1.09
5	I will like to know more on how to use activity-based lesson on other topics in maths	10	19	72	75	3.20	.58
6	Activity-based lesson do waste time.	25	31	65	52	2.13	1.05
7	I cannot relate the activities to mathematics concepts that I am learning.	73	48	31	20	2.94	1.12
8	Time available for mathematics lesson on the time-table is too short for activities, so, I will not use it.	66	45	48	17	2.91	1.02
9	All the needed materials for activities are not readily available, therefore the strategy cannot work.	50	50	43	31	2.65	1.11
10	To improvise materials might be costly at times and also time consuming.	13	33	51	74	1.86	1.00

11	There is the need to carry out training for in-service primary maths teachers on activity-based strategy because it is the solution to mass failure in maths.	10	18	65	75	3.07	1.08
12	Most of the activities require more time, therefore, there must be a system of using it in the primary schools now.	10	15	73	78	3.24	.84
13	I will use activity-based lesson, only if manipulative materials are supplied by the school.	16	38	66	56	2.08	.95
14	I will improvise materials to teach pupils maths in activity-based lesson so that they could understand better.	22	17	58	74	2.99	1.13
15	I can use my personal money to buy manipulative materials to teach pupils primary maths.	43	25	55	44	2.47	1.25
16	I will rather demonstrate with materials and allow the students to observe than using chalk and talk method	22	16	66	66	2.93	1.13
17	Teacher centred activity-based teaching is better than the direct instruction method commonly used by primary mathematics teachers	18	59	35	54	2.60	1.19
18	If I do not have enough materials to go round the pupils, I will use direct instruction to teach primary maths and not demonstration with materials	54	53	46	23	2.22	1.02
19	Pupils activity-based and teacher demonstration is better than direct instruction strategy for primary maths	25	28	78	45	2.81	.98

20	I prefer direct instruction to both pupils activity-based and teacher demonstration strategy to teach primary maths.	25	38	72	40	2.26	.99
	Weighted Average	**2.74**					

Table 4.2.1 reveals that the pre-service teachers agreed with the following: that teaching primary Mathematics with activity-based instructional strategy will bring about meaningful learning (mean = 3.39); that foundation for in-depth understanding of Mathematics at higher level of education could only be laid by activity-based teaching (mean = 2.8); that they prefer activity-based mathematics lesson to teacher-centred lesson ((mean = 3.22); that they will like to know more about how to use activity-based lesson on other topics in Mathematics (mean = 3.2); they do understand mathematics concept better when learnt through activity-based than teacher-centred method (mean = 2.98); that they would rather demonstrate with materials and allow the pupils observe than use chalk and talk method (mean = 2.93); that pupils-centred activity-based and teacher demonstration is better than direct instruction for primary Mathematics (mean = 2.81); that they will improvise materials to teach pupils Mathematics in activity-based lesson so that they could understand better (mean = 2.99). All these show that the pre-service teachers have positive perception about activity-based strategies.

The table also show that the pre-service teachers disagreed with the following negative statements: that activity-based lesson do waste time (mean = 2.13); that to improvise might be too costly for them and time consuming (mean = 1.86); that they will use activity-based strategies only if the school supplied them (mean = 2.08); that they will use direct instruction if materials are not enough (mean = 2.22) and that they prefer direct instruction to the activity-based strategies (mean = 2.26). This also buttresses the fact that the pre-service teachers have positive perceptions about activity-based strategies. The weighted average of the table is 2.74, which is a numerical indicator that the perception of the pre-service teachers is positive.

RQ2. What part of lesson planning skills of activity-based strategies do the pre-service teachers exposed to the training find difficult?

To answer this question, a scale of 3-point was used to score the lesson plans prepared by the pre-service teachers. Four areas of the plan were scored, these are the behavioural objectives, identification of materials, identification of pupils/teacher activities and assessment methods. Each of these areas of the lesson plan has 8 items, therefore, the scale has 32 items in it and the maximum mark obtainable is 96. Table 4.2.2 presents the pre-service teachers exposed to TDS and PABIS performances in activity-based lesson planning skills.

Table 4.2.2: Pre-service Teachers Performances in the Key Areas of Activity-based Lesson Plan

Parts of Lesson Plan	Activity-based		Teacher Demonstration	
	Mean(%)	Std.D	Mean(%)	Std.D
Behavioural Objectives	14.78 (59.12)	3.42	16.00 (64.0)	2.15
Identification of Materials	14.40 (57.6)	4.37	15.44 (61.8)	2.38
Identification of Pupils/teacher Activities	12.63 (50.5)	3.51	15.19 (60.8)	2.24
Assessment methods	10.84 (43.4)	3.38	15.13 (60.5)	2.14
Weighted Average	13.16 (52.6)		15.44 (61.8)	

Table 4.2.2 reveals that generally, the group exposed to Teacher demonstration have a higher lesson planning score (61.8%) than those exposed to activity-based strategy (52.6%). The

table also reveals that those exposed to teacher demonstration scored above 60% in all the four key areas of the lesson planning: behavioural objective (64%); materials (61.8); activities (60.8%) and assessment (60.5%). However, their scores are low in selection of activities and assessing activity-based instructions. Those exposed to pupils-centred activity-based strategy scored less than 60% in all the four key areas of the lesson planning: behavioural objective (59.1%); materials (57.6%); activities (50.5%) and assessment (43.4%). Again, the scores are low in identification of activities and assessing activity-based instructions.

With these, it could be inferred that those exposed to teacher demonstration acquired the skills of planning activity-based lesson better than those exposed to pupil-centred activity-based, but the two groups experienced difficulties in the area of identification of pupils/teacher activities and in the area of assessing activity-based lesson.

RQ3: What are the difficulties faced by the pre-service teachers exposed to activity-based strategies in the process of using it to teach primary Mathematics?

Table 4.2.3: Summary of Pre-Service Teachers' Performance in the Eight Areas of Lesson Delivery across the Two Experimental Groups

Exp. Groups	Motiv. (10)	Activities (15)	Mat. (15)	Sub. Mastery (15)	classR. Atm. (15)	Assess. (15)	Next step (5)	Teacher dem. (10)
TDAS	4.4 (44.0)	7.3 (48.7)	8.1 (54.0)	7.1 (47.3)	7.8 (52.0)	6.4 (42.7)	2.2 (44.0)	6.1 (61.0)
PABIS	5.6 (56.0)	10 (66.7)	9.8 (65.3)	8.5 (56.7)	8.5 (56.7)	8.6 (57.3)	2.4 (48.0)	5.9 (59.0)

NOTE: *Mark obtainable in bold parentheses; percentages in parentheses.*

Table 4.2.3 reveals that the pre-service teachers exposed to TDAS scored 44%, 49%, 54%, 47%, 52%, 43%, 44% and 61% in the area of motivating, pupils/teachers activities, using materials, subject mastery, classroom atmosphere, assessment, next step of action and teachers demeanour of lesson presentation respectively. . This implies that these teachers faced difficulties in the area of motivating students, presenting pupils/teachers activities, in-depth understanding of the subject matter, assessing learning during teaching and taking decision on the next action to be taken because they scored below average in all these areas. The total score of pre-service teachers exposed to TDAS on lesson presentation is 49%, which is below average.

It is also shown that pre-service teachers exposed to PABIS scored 56%, 68%, 65%,57%, 57%, 57%, 48% and 59% in the area of motivating, pupils/teachers activities, using materials, subject mastery, classroom atmosphere, assessment, next step of action and teachers demeanour of lesson presentation respectively. This implies that the only place those exposed to PABIS have difficulty is in the area of deciding the next step of action. The total lesson presentation score of pre-service teachers exposed to PABIS is 59%. Therefore, it can be inferred that those exposed to PABIS had less difficulties in presenting activity-based primary mathematics lessons than those exposed to TDAS. Figure 4.2.1 gives further graphic information on this:

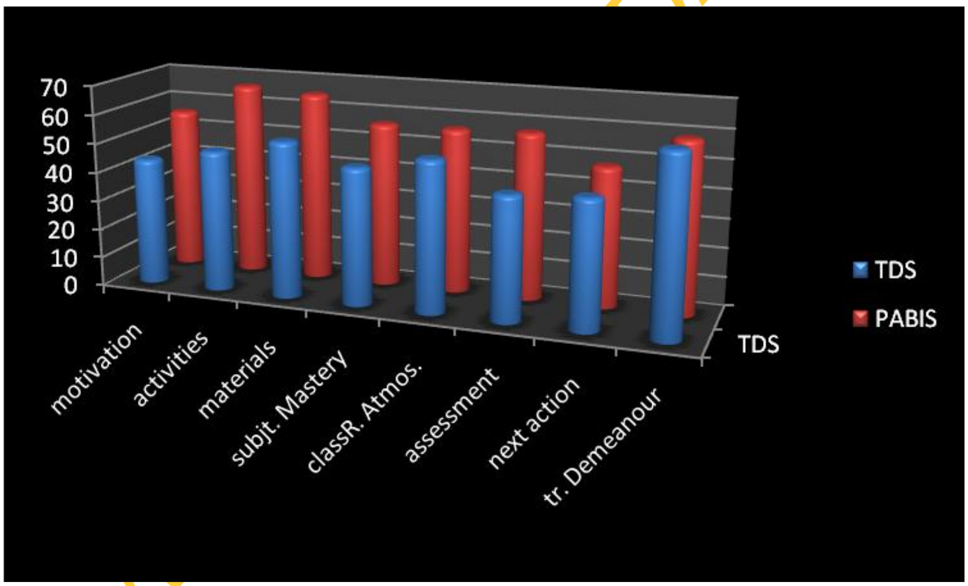


Fig. 4.2.1: Bar Chart Showing Performance of Pre-service Teachers Exposed to TDAS and PABIS in the Areas of Lesson Presentation

4.3: Testing the Null Hypotheses

Ho_1: There is no significant main effect of treatment on pre-service teachers' lesson planning skills.

Table 4.3.1: Summary of Analysis of Covariance (ANCOVA) on Pre-service Teacher Lesson Planning Score

Dependent Variable: TOTAL POST SCORE

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	197123.922[a]	18	10951.329	145.959	.000	.892
Intercept	153309.767	1	153309.767	2043.307	.000	.865
PRESCORE	.053	1	.053	.001	.979	.000
TRTMT	94260.681	2	47130.341	628.151	.000	.798
NUABRATE	18.170	2	9.085	.121	.886	.001
GENDER	6.667	1	6.667	.089	.766	.000
TRTMT * NUABRATE	173.872	4	43.468	.579	.678	.007
TRTMT * GENDER	329.591	2	164.796	2.196	.113	.014
NUABRATE * GENDER	6.374	2	3.187	.042	.958	.000
TRTMT * NUABRATE * GENDER	33.845	4	8.461	.113	.978	.001
Error	23859.609	318	75.030			
Total	663587.000	337				
Corrected Total	220983.531	336				

a. R Squared = .892 (Adjusted R Squared = .886)

Table 4.3.1 reveals that there is a significant main effect of treatment on pre-service teachers' lesson planning skills ($F_{(2,318)} = 628.15$; $P<0.05$; partial $\eta^2 = .80$). Therefore, H_{01} is rejected. The effect size is given to be 80%. Table 4.3.2 reveals the magnitude of performance across the groups.

Table 4.3.2: Estimated Marginal Means on the Treatment, Numerical Ability and Gender

Variable		N	Mean	Std. Error
Intercept				
	Grand mean (Post-score mean)	337	42.81	.76
	Pre-score mean	337	13.93	.61
Treatment				
	Activity-based (Exp 1)	73	55.37	1.30
	Teacher Demonstration (Exp 11)	103	61.73	1.70
	Conventional (control)	161	11.32	.81
Numerical Ability				
	Low	200	42.53	.76
	Average	90	42.44	1.08
	High	47	43.46	1.86
Gender				
	Male	111	42.58	1.32
	Female	226	43.03	.75

Table 4.3.2 reveals that the pre-service teachers exposed to teacher demonstration have the highest activity-based lesson planning score (61.73); followed by those exposed to activity-based (55.37) while those exposed to conventional teaching have the lowest activity-based lesson planning score (11.32). These information are represented in a chart below

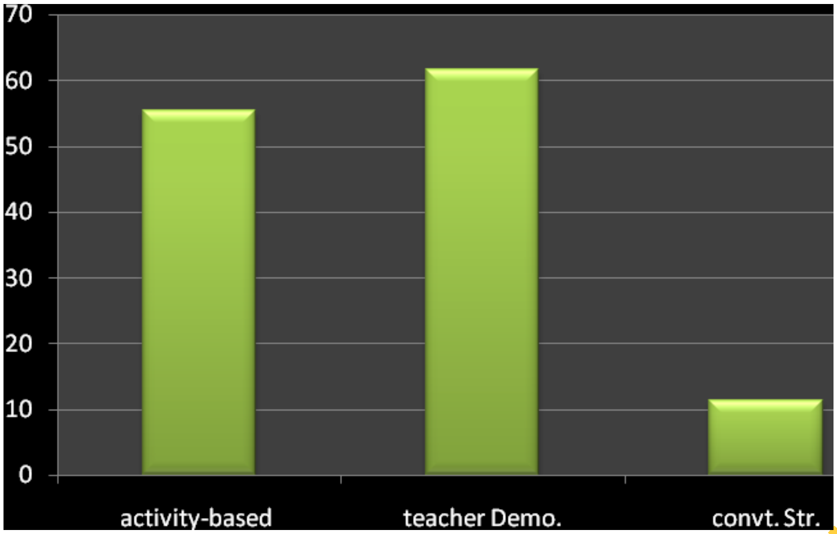


Fig. 4.3.1: Bar Chart Showing Level of Lesson Planning Skills Acquired by the Pre-Service Teachers after Training

Table 4.3.3 shows the source(s) of the significant difference by pairwise comparison.

Table 4.3.3: Summary of Scheffe's Post Hoc Pairwise Comparison of the Scores within the Three Groups

Treatment	Mean score	Exp.1	Exp.11	Control
Pupil-centred Activity-based (Exp. 1)	55.37		*	*
Teacher Demonstration (Exp. 11)	61.73	*		*
Conventional (Control)	11.32	*	*	

Table 4.3.3 reveals that the significant main effect exposed by table 4.3.1 is as a result of the significant difference between:

i. Activity-based and Teacher demonstration
ii. Activity-based and Conventional
iii. Teacher demonstration and Conventional

This implies that those exposed to teacher demonstration performed significantly better than those exposed to activity-based instructional strategy and that those exposed to activity-based instructional strategy performed significantly better than those exposed to conventional strategy.

Ho$_2$: There is no significant main effect of numerical ability on pre-service teachers' lesson planning skills

Table 4.3.1 presented earlier showed that there is no significant main effect of numerical ability on pre-service teacher lesson planning skills ($F_{(2,318)} = 0.12$; $P>0.05$; partial $\eta^2 = .001$). Therefore, H_{02} is not rejected. Table 4.3.2 also showed the lesson planning mean score according to the numerical ability. Those with low numerical ability have lesson planning mean score of 42.53; those with average numerical ability have 42.44 and those with high numerical ability have 43.46. The differences among these values have been shown not to be significant.

Ho$_3$: There is no significant main effect of gender on pre-service teachers' lesson planning skills.

Table 4.3.1 revealed that there is no significant main effect of gender on pre-service teachers' lesson planning skills ($F_{(1,318)} = 0.09$; $P>0.05$; partial $\eta^2 = .00$). Therefore, H_{03} is not rejected. Table 4.3.2 also revealed the lesson planning mean score of the male pre-service teachers to be 42.58 and that of the female is 43.03. The difference between these values is not significant.

Ho$_4$: There is no significant interaction effect of treatment and numerical ability on pre-service teachers' lesson planning skills.

It is shown in table 4.3.1 which indicates that there is no significant interaction effect of treatment and numerical ability on the pre-service teachers' lesson planning skills ($F_{(4,318)} = 0.58$; $P>0.05$; partial $\eta^2 = .01$). Therefore, H_{04} is not rejected.

Ho$_5$: There is no significant interaction effect of treatment and gender on pre-service teachers' lesson planning skills.

Table 4.3.1 revealed that there is no significant interaction effect of treatment and gender on Pre-service teachers' lesson planning skills ($F_{(2,318)} = 2.20$; $P>0.05$; partial $\eta^2 = .01$). Therefore, H_{05} is not rejected.

Ho$_6$: There is no significant interaction effect of numerical ability and gender on pre-service teachers' lesson planning skills.

Table4.3.1 revealed that there is no significant interaction effect of numerical ability and gender on the pre-service teachers' lesson planning skills ($F_{(2,318)}$ = 0.04; P>0.05; partial η^2 = .00). Therefore, H_{06} is not rejected.

Ho$_7$: There is no significant interaction effect of treatment, numerical ability and gender on pre-service teachers' activity-based lesson planning skills.

Table 4.3.1 revealed that the 3-way interaction of treatment, numerical ability and gender on pre-service teachers' lesson planning skills is not significant ($F_{(4,318)}$ = 0.11; P>0.05; partial η^2 = .00). Hence, H_{07} is not rejected.

Ho$_8$: There is no significant difference among pre-service teachers exposed to TDAS, PABIS and Conventional strategies in their activity-based mathematics lesson delivery after the training.

It should be noted that some level of mortality was experienced during the collection of lesson delivery data. Twenty-one (21) students out of the 337 were not found. Therefore, 316 participants were observed.

Table 4.3.4: Summary of Analysis of Variance (ANOVA) Showing Difference between Treatment Groups, Numerical Ability and Gender on Pre-service Teachers Lesson Delivery

Dependent Variable: lesson plan utilization score

Source	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	8838.969[a]	17	519.939	11.222	.000	.390
Intercept	504519.227	1	504519.227	10889.073	.000	.973
trtmt	5896.327	2	2948.164	63.630	.000	.299
NUMABIL	43.543	2	21.771	.470	.626	.003
GENDER	7.652	1	7.652	.165	.685	.001
trtmt * NUMABIL	87.144	4	21.786	.470	.758	.006
trtmt * GENDER	237.008	2	118.504	2.558	.079	.017
NUMABIL * GENDER	98.299	2	49.149	1.061	.347	.007
trtmt * NUMABIL * GENDER	19.400	4	4.850	.105	.981	.001
Error	13807.120	298	46.333			
Total	817654.000	316				
Corrected Total	22646.089	315				

a. R Squared = .390 (Adjusted R Squared = .356)

Table 4.3.4 reveals that there is a significant difference between the treatment groups in pre-service teachers' primary mathematics activity-based lesson delivery ($F_{(2,\ 298)} = 63.63$; $P<0.05$; partial $\eta^2 = 0.30$). Therefore, Ho8 is rejected. The treatment has the effect size of about 30% of the total variance in the dependent variable (Partial eta square = 0.29). Table 4.3.5 presents the magnitude of lesson delivery performance across the groups.

Table 4.3.5: Estimated Marginal Means Showing the Lesson Presentation Scores of the Pre-Service Teachers across the Groups

Treatment	Mean	Std. Error	Partial eta sq.
TDS	49.69	.89	
PABIS	59.36	.89	.299
Convent.	46.15	.80	

Table 4.3.5 reveals that those exposed to PABIS had the highest activity-based lesson delivery mean score (59.4), followed by those exposed to TDAS (49.7) while those exposed to conventional strategy had the lowest mean score (46.2). Figure 4.3.2 shows this in a chart.

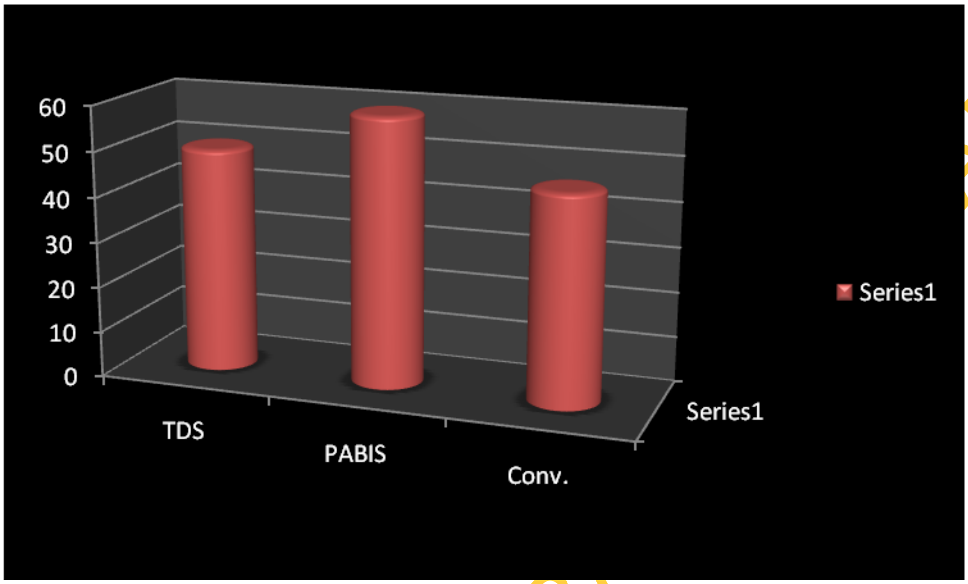


Fig. 4.3.2: Bar Chart Showing Pre-service Teachers Activity-based Lesson Delivery Scores across the Three Groups

Further, in order to determine the source(s) of the significant difference among these three groups in their level of activity-based lesson delivery scores, pair wise comparison analysis was carried out. Table 4.3.6 presents the results.

Table 4.3.6: Pairwise Comparison of Scheffe's Post Hoc Analysis Showing Sources of Significance

Treatment groups	Mean	TDS	PABIS	Conv.
TDS	49.7		*	*
PABIS	59.4	*		*
Conv.	46.2	*	*	

Table 4.3.6 reveals that the significant difference among the three groups exposed by table 4.3.4 was as a result of the significant difference between:

a. TDAS and PABIS
b. TDAS and Conventional
c. PABIS and Conventional

The implication of this is that those exposed to PABIS performed significantly better than those exposed to TDAS in activity-based lesson delivery while those in TDAS performed significantly better than those exposed to conventional strategy.

Ho9: There is no significant difference among pre-service teachers with low, average and high numerical ability in their activity-based mathematics lesson delivery after training.

Table 4.3.4, shows that there is no significant difference among pre-service teachers with low, average and high numerical ability in their activity-based primary mathematics lesson presentation ($F_{(2, 298)} = 0.47$; $P>0.05$; partial $\eta^2 = 0.003$). Hence, Ho9 is not rejected. The partial eta square reveals that numerical ability accounted for just 0.3% of the total variance in the activity-based lesson delivery of the pre-service teachers.

Ho10: There is no significant difference between male and female pre-service teachers in their activity-based mathematics lesson delivery after training.

Table 4.3.4 reveals that there is no significant difference between male and female pre-service teachers in their activity-based primary mathematics lesson delivery ($F_{(1, 298)} = 0.17$; $P>0.05$; partial $\eta^2 = 0.001$). Therefore, Ho10 is not rejected. The partial eta square reveals that gender accounted for just 0.1% of the total variance in the activity-based lesson delivery of the pre-service teachers.

Ho11: There is no significant difference among pre-service teachers in their academic performance in PES 122.

The analysis here is based on 316 participants that had the post score of the lesson delivery

Table 4.3.7: Summary of ANOVA Showing Effect of Treatment on Academic Performance of Pre-service Teachers in Mathematics Methodology Course

Dependent Variable:score

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.	Partial Eta Squared
Corrected Model	9012.895[a]	17	530.170	10.777	.000	.381
Intercept	499360.635	1	499360.635	1.015E4	.000	.971
Trtmt	6521.295	2	3260.647	66.279	.000	.308
Numabil	23.376	2	11.688	.238	.789	.002
Gender	62.664	1	62.664	1.274	.260	.004
Trtmt * numabil	112.386	4	28.097	.571	.684	.008
Trtmt * gender	273.517	2	136.758	2.780	.064	.018
numabil * gender	37.306	2	18.653	.379	.685	.003
Trtmt * numabil * gender	27.760	4	6.940	.141	.967	.002
Error	14660.404	298	49.196			
Total	817828.750	316				
Corrected Total	23673.300	315				

a. R Squared = .381 (Adjusted R Squared = .345)

Table 4.3.7 shows that there is a significant difference among pre-service teachers exposed to TDAS, PABIS and Conventional strategies in their academic performance in mathematics methodology course, PES 122 ($F_{(2, 298)} = 66.28$; $P<0.05$; partial $\eta^2 = .31$). Therefore, Ho11 is rejected. The partial eta square reveals that the treatment accounted for 31% of the total variance in the pre-service teachers' academic performance in PES 122. Table 4.3.8 reveals the magnitude of performance across the groups

Table 4.3.8: Estimated Marginal Means Showing Performances of Pre-service Teachers in PES 122 across the Institutions

Treatment	N	Mean	Std. Error
TDAS	101	49.69	.91
PABIS	72	59.36	.91
Conv.	143	45.36	.83
Total	316	49.21	1.29

Table 4.3.8 reveals that pre-service teachers exposed to PABIS had the highest mean score in PES 122 examination (59.4), followed by those exposed to TDAS (49.7) and those exposed to Conventional strategy scored the lowest (45.4). Table 4.3.9 shows the pair wise comparison of the pre-service teachers' achievement in order to reveal the sources of significance.

Table 4.3.9 Summary of Pair wise Comparison of pre-service Teachers' Academic Performance in PES 122

Treatment Groups	Mean score	TDS	PABIS	Conv.
TDAS	49.69		*	*
PABIS	59.36	*		*
Conv.	45.36	*	*	

Table 4.3.9 reveals that the significant main influence of treatment on academic achievement of the pre-service teachers in PES 122 is as a result of significant difference between those exposed to:

i. PABIS and TDAS strategies

ii. PABIS and Conventional strategies and

iii. TDAS and Conventional strategies.

These indicate that those exposed to Pupil-centred Activity-based Instructional Strategy (PABIS) performed significantly highest, those exposed to Teacher Demonstration performed significantly higher while those exposed to Conventional Strategy performed the lowest. Figure 4.3.3 shows the performance in a chart form.

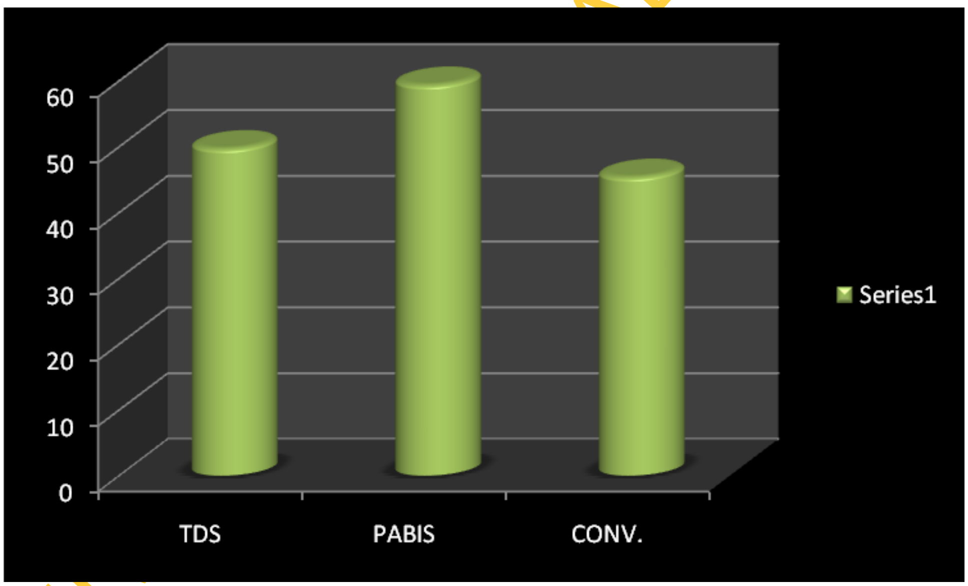


Fig. 4.3.3: Bar Chart Showing Academic Performances of the Pre-service Teachers across the Groups

4.4: Summary of Findings

Based on the analysis and the interpretation of the data collected in this study, the following are the summary of the findings:

- ✓ The pre-service teachers have positive perceptions about the effectiveness of activity-based strategies in the teaching of primary Mathematics.
- ✓ The two groups (Those in TDAS and those in PABIS) experienced difficulties in the area of selection of pupils/teacher activities and in the area of assessing activity-based lesson. But those exposed to PABIS have more difficulties than those exposed to TDAS.
- ✓ Those exposed to TDAS faced difficulties in the area of motivating students, presenting pupils/teachers activities, in-depth understanding of the subject matter, assessment of learning during teaching and taking decision on the next action to be taken. Those exposed to PABIS had difficulty only in the area of deciding the next step of action. Therefore, it could be inferred that those exposed to PABIS had less difficulties in presenting activity-based primary mathematics lessons than those exposed to TDAS.
- ✓ There is a significant main effect of treatment on pre-service teachers' activity-based lesson planning skills.
- ✓ There is no significant main effect of numerical ability on pre-service teachers' activity-based lesson planning skills.
- ✓ There is no significant main effect of gender on pre-service teachers' activity-based lesson planning skills.
- ✓ There is no significant interaction effect of treatment and numerical ability on the pre-service teachers' activity-based lesson planning skills.
- ✓ There is no significant interaction effect of treatment and gender on pre-service teachers' activity-base lesson planning skills.
- ✓ There is no significant interaction effect of numerical ability and gender on the pre-service teachers' activity-based lesson planning skills and

- ✓ The 3-way interaction of treatment, numerical ability and gender on pre-service teachers' activity-based lesson planning skills is not significant.
- ✓ There is a significant difference among pre-service teachers exposed to TDAS, PABIS and conventional strategies in their activity-based primary mathematics lesson delivery. Those exposed to PABIS had the highest activity-based lesson presentation mean score, followed by those exposed to TDAS while those exposed to conventional strategy had the lowest mean score.
- ✓ There is no significant difference among pre-service teachers with low, average and high numerical ability in their delivery of primary mathematics activity-based lesson.
- ✓ There is no significant difference between male and female pre-service teachers in their delivery of primary mathematics activity-based lesson.
- ✓ There is a significant difference among pre-service teachers exposed to TDAS, PABIS and conventional strategies in their academic performance. Those exposed to PABIS had significantly highest mean score in PES 122 examination, followed by those exposed to TDAS and those exposed to Conventional Strategy scored the lowest.

CHAPTER FIVE

DISCUSSION OF FINDINGS, CONCLUSION AND RECOMMENDATIONS

5.1 Discussion of Findings

5.1.1: Main Effect of Treatment on Acquisition of Lesson Planning Skills

The major concern of this study was to investigate the impact of activity-based instructional strategies on pre-service teachers' lesson planning and delivery skills. Based on this, the first hypothesis tested was that the main effect of treatment on the pre-service teachers' lesson planning skills is not significant. It was found that there was a significant main effect of treatment on pre-service primary mathematics teachers' lesson planning skills. Those exposed to Teacher Demonstration instructional strategy gained most, with respect to the skills of planning activity-based mathematics lessons, followed by those exposed to Pupil-centred Activity-based Instructional Strategy while those exposed to conventional strategy gained the least. To show this effect further, the mean gain at the post-test level over the pre-test across the three groups was 28.9 points. This finding was as a result of the effect of the instructional strategy used on the acquisition of lesson planning skills. In the first experimental group, the pre-service teachers were made to learn these skills in various ways, including: being taught using the strategy; being made to be learners in the activity-based mathematics lessons; being allowed to access various activity-based lesson plans and being made to discuss the features of this type of lesson plan. Therefore, the pre-service teachers were able to gain a lot about planning primary mathematics lessons for this type of instructional strategy. This is in line with the submission of the National Policy on Education (FGN, 2004) that Mathematics should be taught in practical way. Nelson and Sassi (2007), Pica, (2008) and Bahr et al (2010) also submitted that learners should do mathematics and not study it. The effectiveness of pupil-centred activity-based instructional strategy is in line with the findings of many studies such as Suydam and Higgins (1977); Wearne and Hiebert (1988); Fuson (1992) and Thompson (1992), Jensen (2008) opined that it will serve a child endlessly, and that, moreover, active, authentic learning is far more likely, than rote learning, to foster a lifelong love of the learning process. Pica (2008) believed that because it is more fun, learners in activity-based mathematics classes learn Mathematics in a relaxed mood.

But the inability of those in PABIS group to gain as more lesson planning skills as those exposed to teacher demonstration could have been accounted for by the fact that this instructional strategy is new to them. Right from primary school to the college, they have been used to teacher-centred method of teaching, note giving in which the only thing they do is to ask or answer questions, write down notes and possibly do some paper/pencil exercises. In this case, the likely explanation is that, given the fact that they were made to explore materials to see mathematical relations, they were too carried away that they concentrated more on the new knowledge being revealed to them than the skills of planning lesson. In fact, occasionally, some of the pre-service teachers do ask the lecturer if there would be any examination on the course at the end of the semester. This revealed that they could not see the classes as 'normal' lessons they are used to. This also corroborates the warning of some scholars about the use of activity-based mathematics lesson (Walkerdine, 1982; Stigler and Baranes, 1988; Ball, 1992). All these scholars have noted some problems in the use of this instructional strategy which are closely related to what was experienced during the treatment periods in this particular experimental group: the slow learners sought for more individual helps; involvement in the activities at times disorganized the classroom that the lecturer had to work harder to keep the class on track; some learners took the lessons to be play time. All these have both negative and positive effects on the skill acquisition.

In the second experimental group, wherein the pre-service teachers were exposed to teacher demonstration instructional strategy, it was discovered that the pre-service teachers in this group acquired the highest level of the skills of planning activity-based primary mathematics lesson. Here, the students were able to gain maximally because the instructional strategy have some elements of direct instruction which they are used to; they were able to observe the manipulation of materials by the lecturer; some of them were invited to demonstrate what was observed, which gave room for learning from their peers; they were given copies of activity-based primary mathematics lesson plans. The only difference is that all the students were not allowed to manipulate materials; instead, materials were manipulated by the lecturer for the students to observe. This lesson delivery is in line with the submission of Loeffler (2010) and Rodriques (2010) that demonstration is a method of teaching that relies heavily upon showing the learner a model performance that he should match or pass after he has seen a presentation that is live, filmed or electronically operated. That this strategy made the pre-service teachers learn faster, better and effectively also corroborates the findings of other scholars such as Mckee, Williamson and Ruebush (2007), Loeffler 2010 and Rodriques 2010. Pre-service teachers in this group enjoyed the activity based teaching and as well they were able to write notes, listened to direct instructions and some of them probably practiced some of the activities on their own. This might have explained why they were able to gain maximally from the treatment.

The pre-service teachers in the control group were exposed to conventional strategy. The conventional strategy in the colleges of education primary mathematics classes can be described as direct instruction or modified lecture method. This is supported by Freudenthal (1991), Cashin (1990), Radford (1991), Bizhan (1996), Korthagen (1993), Rieg and Wilson (2009) and Salami (2009). Pre-service teachers in this group were exposed to instructions in primary Mathematics where the lecturer introduces the topic, gave the formula (where necessary), worked some exercises as examples and gave some problems to the students to solve on their own. Occasionally, the lecturer informed the students that the best way to teach primary Mathematics was through activity-based strategy. These students were unable to plan activity based mathematics lesson at the post test level because they were not taught how to nor were they taught using the strategy. This also explains why almost all primary school teachers in Nigeria at present find it difficult to plan, deliver and evaluate activity-based mathematics lessons (Baki, 1997; Buck, 2004; ESA, 2004; Odu, 1985; NTI, 2007). This finding also supports the fact that of all the factors affecting students' learning, teacher related factors—especially the pedagogical factors—were found to be strong predictor (Slavin et al, 1995; Anderson and Pellicer, 1998; McBer, 2000 and Anderson, 2004). The strategies adopted in the three groups of this study have shown that teacher's pedagogical knowledge is highly important to the learning of the students. Conventional strategy, or what is known as modified lecture or direct instruction, cannot encourage active learning in adult students like those in colleges of education. This is in line with the submission of Filene (2005) who observed that pre-service teachers have grown up expectations and demand more than a 'talking head'. He stated that best lecturers add variety into their teaching. Finkel (2000) noted that transmitting information from a teacher's head to a student's notebook is an inadequate objective for teacher training institution. Two reasons were raised for the failure of lecture method by Rieg and Wilson (2009): the first being that lecturers presume students have had experiences they have not had and the second being that in the typical lecture, reflection is done by the lecturer and not by the students. The lecturers of primary mathematics methodology courses most often assume that the students have learnt most of the topics they are teaching in primary and secondary schools; hence they are just to remind them.

But it has been established that performance of the pupils as well as the secondary school students in Mathematics is below expectation (ESA, 2004). Therefore, most of the lectures in primary mathematics classes in the colleges are based on vacuum and many students may not ask questions because this may affect their self esteem. Scholars have noticed the shortcomings of the conventional strategy a long time ago and they advocated the developments in mathematics education through the introduction of so-called "realistic mathematics education" (Treffers, 1987; Freudenthal, 1991). This new mathematics pedagogy is characterized by a complete break with the traditional approach, which goes from "theory" (formulae, principles, rules, theorems) to applications.

5.1.2: Main Effect of Numerical Ability on Acquisition of Lesson Planning Skills

This study also revealed that there was no significant main effect of numerical ability of the pre-service teachers on their acquisition of activity-based lesson planning skills. In fact, the difference between those with low and high numerical ability in their post-scores in activity-based lesson plan is less than 1. The gap between these groups in the numerical ability is so wide- the highest score of low-numerical-ability-pre-service teachers is 8 while the least score for the high-numerical-ability pre-service teachers is 14; therefore, the gap between the two in their numerical ability is 6points. This finding could be as a result of the fact that the treatment given to the participants made Mathematics more real and concrete and thus demystified the abstraction that is commonly associated with the subject. Besides, what were measured were the skills acquired in planning mathematics lesson which require creativity in Mathematics than knowledge memorization. In other words, according to Lee Shulman's category of teaching knowledge, pedagogical content knowledge (PCK) was emphasised here and not subject matter knowledge (SMK). However, the numerical ability is more of the SMK than the PCK (Goulding, Rowland and Barber, 2002). Therefore, the amount of memorization in number work which the teachers possessed has little or no effect on what they were able to learn. Another reason could be that what was expected of the pre-service teachers was either done for them to observe (in teacher demonstration group) or they were allowed to do it (in pupil-centred activity-based group) many times. In these two strategies, the pre-service teachers were made to learn Mathematics in a different way and they were able to see Mathematics as being the result of human activities and not as an entity that exist outside there to be discovered (NTI, 2007).

Therefore, what the teachers already knew about Mathematics has no effect on what they were able to acquire. The implication of this is that if lecturers of primary mathematics methodology courses in the colleges use activity-based instructional strategies, it would, very likely, compensate for many inadequacies in the numerical ability of the pre-service teachers' acquisition of teaching skills. This is not to say that numerical ability cannot influence the teachers teaching as rightly observed by Alexander et al (1992) (Office for Standards in Education [OFSTED] 1994). It is important to note that the finding contradicts the work of Kennedy (1997) and Raths and Roy (2005) who concluded that knowledge of subject matter is an important prerequisite to effective teaching. This could only happen when the type of teaching is the one deeply rooted in mathematics fact, theorem, rules and regulations through direct instruction. But if it is the type of teaching that emphasise doing Mathematics, SMK has little effect. That is why it is an axiomatic truth that mere "knowing" more Mathematics does not ensure that one can teach it in ways that enable students to develop the mathematical power and deep conceptual understanding envisioned (NCTM, 2000).

5.1.3: Main Effect of Gender on Acquisition of Lesson Planning Skills

This study found out that there was no significant main effect of pre-service teachers' gender on their acquisition of skills of planning activity-based primary mathematics lesson. The mean scores of activity-based lesson planning skills after exposing the teachers to the treatment revealed that the difference between male and female is 0.4 in favour of female teachers, though the difference is not statistically significant. This finding could be as a result of the fact that the lesson planning skills has little to do with rigorous mathematical calculations, area where females do not do as well as their male colleagues, especially at the higher level of education (Berube and Glanz, 2008). Besides this, it could also have been the effect of the instructional strategies used which were able to demystify mathematics concepts while rendering it more comprehensible and concrete and real to life.. Becker (2003) supports this opinion by saying that traditional ways of teaching Mathematics-stressing certainty, a single correct answer, deduction, logic, argumentation, algorithms, structure, and formality- may be particularly incompatible with the ways in which many females learn. Berube and Glanz (2008) argued that the gap between a male and a female child in Mathematics could be diminished and that this gap can be successfully eradicated by using better teaching methods. It has also been suggested that constructivist teaching could alter the imbalance in the mathematics classroom (Berube and Glanz, 2008). The two activity-based strategies used in this study found their root in constructivism and one of the merits of instructional strategy that adopted this theory is that it allows females to learn abstract subjects as well as their male colleagues. Therefore, the female pre-service teachers were able to understand better because the learning was more of doing than just some abstract explanation from a single source (Hanson, 2001).

In fact, the finding that there is no significant difference between the performance of male and female pre-service teachers in primary mathematics activity-based lesson planning supports many past findings suggesting that the gap between male and female learners in Mathematics has been bridged quite significantly (Spencer, Steel and Quinn, 1999; Austin, 2002; David, 2003; Berube and Glanz, 2008). Arigbabu and Mji (2004) found out that in academic performance of pre-service teachers over three academic sessions, there was no significant difference between the scores of male and female students in Mathematics. Though male students do have higher mean scores over the three years but the difference is shown not to be statistically significant.

This finding also corroborates the finding of Wong and Lai (2006) who while examining the effect of gender on pre-service teachers' teaching effectiveness found that those female pre-service teachers taught better than their male counterparts. The supervisions also indicated that female student-teachers' instructional strategies were more creative and well designed than male student-teachers. Therefore, this finding should not be jettisoned.

5.1.4: The 2 and 3-way Interaction Effects of Treatment, Numerical Ability and Gender on the Acquisition of Lesson Planning Skills

In further exploring the data collected in this study, the level of lesson planning skills acquisition in each of the three groups were examined. The examination was done with respect to the acquisition of the activity-based mathematics lesson planning skills according to the pre-service teachers' numerical ability. Here, it was discovered that there was no significant interaction effect of treatment and numerical ability on the acquisition of activity-based mathematics lesson planning skills of the pre-service teachers. This implies that the difference among low, average and high mathematics ability teachers in the three groups in their activity-based lesson planning skills is not statistically different. The mean scores of these categories of pre-service teachers across the groups reveal more information. Pre-service teachers with low numerical ability have higher activity-based lesson planning mean scores in the experimental groups than in the control group. The mean scores of low, average and high numerical ability teachers exposed to PABIS are 54.4, 53.3, 58.4; that of those exposed to TDAS are 62.2, 62.1, 60.9 and those exposed to CS have 11.0, 11.9, 11.1 respectively. The implication of this is that in those groups where activity-based strategies were used, the pre-service teachers do not only perform higher but those with low numerical ability performed higher too. Unlike what happened with those exposed to conventional strategy where pre-service teachers with low numerical ability performed least. This finding clearly revealed that the use of activity-based instructional strategies will enhance the acquisition of PCK of the pre-service teachers irrespective of their background in primary Mathematics. This supports Jensen's (2008) observation that physical activity activates the brain much more than doing seatwork or paper/pencil work. While sitting increases fatigue and reduces concentration, movement feeds oxygen, water, and glucose to the brain, optimizing its performance. Furthermore, learning by doing creates more neural networks in the brain and throughout the body, making the entire body a tool for learning (Hannaford, 2005). Active learning is also more fun for learners (Pica, 2008).

This finding is in line with the argument of Rieg and Wilson (2009) that active learning strategies is one of the best teaching practices that can be adopted by college teachers. Good teaching in the college was viewed as the creation of those circumstances that lead to significant learning in the pre-service teachers. Many other scholars have pointed out that the use of only lecture method by college teachers has been responsible for the sub-standard primary teachers available in the country (Finkel, 2000; Filene, 2005; Rieg and Wilson, 2009).

The analysis of the data of this study further revealed that there was no significant interaction effect of treatment and gender on pre-service teachers' acquisition of skills for planning activity-based primary mathematics lesson. Generally, this implies that there is no significant difference between male and female pre-service teachers in their level of acquiring lesson-planning skills across the groups. But further examination of the mean scores of male and female across the groups revealed that female pre-service teachers have higher mean score among those exposed to PABIS (57.7 to 53.1) while male pre-service teachers have higher score among those exposed to TDAS (62.6 to 60.9) and CS (12.1 to 10.5). The reason for this is not farfetched; it could be as a result of the fact that it is only in PABIS that the pre-service teachers were made to explore materials in order to create their learning. This strategy was based mainly on materials exploration, manipulation and creation based on mathematical ideals being examined. In other words, it is only in this strategy that constructivism is fully applied wherein pre-service teachers were able to see and experience Mathematics in a practical way. This finding is in tandem with the submission of many scholars (Belenky et al, 1997; Hanson, 2001; Becker, 2003) who maintain that active learning enhances female students' learning more than the passive learning, especially in regard to an abstract subject like Mathematics. Becker (2003) supports this by saying that traditional ways of teaching Mathematics-stressing certainty, a single correct answer, deduction, logic, argumentation, algorithms, structure, and formality- may be particularly incompatible with the ways in which many females learn. This view is also indicated in the suggestion of some scholars (Berube and Glanz, 2008) to the effect that constructivist teaching could alter the imbalance in the mathematics classroom. Berube and Glanz (2008) reported that the gap between a male and a female child is diminishing and that this gap can be successfully eradicated by using better teaching methods.

The analysis of the data also shows that there was no significant interaction effect of numerical ability and students' gender on their acquisition of activity-based primary mathematics lesson planning skills. This simply means that the difference between male and female pre-service teachers who have low, average and high numerical ability is not significant. Despite that, it is shown that female pre-service teachers with low and average numerical ability have higher activity-based lesson planning mean scores than their male counterparts. But those of them with high numerical ability have almost the same mean scores. Though the difference between them is not significant, it can nevertheless be claimed that both male and female, irrespective of their numerical ability, will acquire activity-based primary mathematics lesson plan skills better if they were trained through activity-based instructional strategies. This finding could be as a result of the fact that activity-based instructional strategies have been shown to reduce the effects of gender and that of numerical ability of the pre-service primary mathematics teachers individually. So, the result that the strategies reduced the effects of these two moderator variables collectively is expected. This finding is in line with other findings of this study already discussed.

This study also revealed that there was no significant interaction effect of treatment, numerical ability and gender on pre-service primary mathematics teachers' acquisition of activity-based lesson planning skills. This finding follows directly from others discussed earlier. It simply means that the treatment given to prepare the pre-service primary mathematics teachers on planning activity-based lesson was able to reduce the influence of the numerical ability as well as the gender on their acquisition of the skills even at the control group. This regardless of the fact that the activity-based lesson planning skills mean scores of those in the control group was so low. In fact, the difference between the mean scores of the group and those in PABIS which followed it was 40 points. Therefore, it seems that those exposed to conventional strategy find it extremely difficult to acquire these skills. This difficulty is irrespective of the pre-service teachers' gender or numerical ability. In other words, be it male or female, the low or high numerical ability of pre-service teacher, if taught with conventional chalk-and-talk method, cannot lead to the planning of activity-based primary mathematics instructions. This finding is in line with the submission of many scholars who maintain that the traditional chalk-and-talk method, does not allow pupils to manipulate or actively explore materials and their environment. Students are only active when copying the notes or when doing some exercises following the teachers' given method. Indeed, this type of teaching has been shown not to be effective in teaching Mathematics (Akinsola, 1994; Richardson, 1997; Oladeji, 1997; O'Brien, 1999; Aremu, 2001, Saeed and Mamood, 2002, Akinsola, 2002; Awofala, 2002; Olosunde, 2009;). This type of teaching, termed *transmission model* by Richardson (1997), is said to promote neither the interaction between prior and the new knowledge nor the conversations that are necessary for internalization and deep understanding.

In context of teacher preparation programmes, this finding is in line with the findings of other scholars who have shown that the inability of primary mathematics teachers to use pupil-centred method of teaching the result of the training received by the teachers since they were not taught using instructional materials (Radford, 1991; Bizhan, 1996; Buck, 2004; Salami 2009) and they were usually taught with no hands-on experience, and no practical Mathematics work. In this regard, the popular saying holds, 'you teach the way you were taught' (Akinbote, 1999; Cruickshank, Jenkins and Metcalf, 2003). Therefore, this study has served to further reveal the weaknesses of the conventional strategy.

5.1.5: Perceptions of Pre-service Primary Mathematics Teachers on Activity-based Instructional Strategies and Mathematics Teaching

It was considered imperative to investigate the perceptions of those pre-service teachers exposed to activity-based instructional strategies because it has been established that perception could influence action. This study found that the pre-service teachers exposed to activity-based strategies had positive perceptions about the effectiveness of the strategies for primary mathematics preparation. They also perceived that these strategies will be more effective in teaching primary Mathematics to the pupils. This could be as a result of the exposure they have during the treatment. Those in the PABIS group experienced hands-on, mind-on mathematics teaching and exploration of the lesson plan. Those exposed to TDAS observed the manipulation of materials by the lecturer which revealed the mathematics concepts and they were also made to explore the lesson plan used by the lecturer. These experiences were new to them, especially in teaching Mathematics. They were also able to acquire the in-depth understanding of Mathematics; therefore, they perceived that the strategies are highly effective. In other words, activity-based instructional strategies are effective in enhancing knowledge as well as improving the attitude of the teachers towards teaching Mathematics. This corroborates the findings of Sowell (1989), English and Halford (1995), Cubey and Dalli (1996), Fuys et al (1988), Suydam and Higgins (1977), Wearne and Hiebert (1988), Fuson (1992), Thompson (1992), Jensen (2008) and Markusic (2009) that activity-based instructional strategies, which are based on constructivism, are highly effective in facilitating students' learning faster, especially in the learning of an abstract subject like Mathematics. Also, Pica (2008) submitted that activity-based learning is the process of exploration and discovery, of acquiring knowledge, of knowing how to acquire it (no one can memorize all the facts!). As Jensen (2008) notes, it will serve a child endlessly, because active, authentic learning is far more likely, than rote learning, to foster a lifelong love of the learning process.

5.1.6: Pre-service Primary Mathematics Teachers Difficulties in Planning Activity-Based lesson

Another important finding of this study is that those exposed to the activity-based instructional strategies were found to experience difficulties in the area of selecting pupils'/teacher's activities and in the area of assessing activity-based lesson. Selection of pupils'/teacher's activities is one of the key features of activity-based instructional strategies. It makes the strategy distinctively different from other strategies and it is always challenging because it is the part of the lesson that demand creativity, especially in Mathematics. Another factor responsible for the challenging nature of this aspect of the lesson plan is that mathematics textbooks do not contain these activities. At present, almost all primary mathematics textbooks are written in such a way that only paper/pencil exercises are used to present the topics; not much of activities is included. Therefore, if a teacher is to use such textbooks as guide, he/she must have in-depth understanding of the topic and be able to relate it to real-life situations. Again such a teacher must be able to come up with the activity that will have the mathematics topic at hand embedded in it; that the pupils will enjoy; that will not take too much time and that could be easily translated to paper/pencil work. This finding corroborates the submissions of Stigler and Baranes (1988) who sounded a note of warning about the use of activity-based strategies; that teachers should be ready to spend extra time for lesson preparation because the strategy is more demanding.

Assessing activity-based instructional strategies was a challenge to the pre-service teachers because it does not rely on only tests and examinations as with direct instruction or modified lecture methods which the pre-service teachers were used to. Other assessment tools like rating scale, observation schedule, checklist and questionnaire are important to the assessment of activity-based lesson. This is simply because the lesson is more of skills acquisition than fact memorization. Designing these assessment tools require extra skills and plenty of time. The use of these tools also demands 'technical knowhow' on the part of the teacher. Therefore, these can be cited as perhaps the reasons for the study's finding that pre-service teachers found it a little bit difficult to plan the area of assessment in the activity-based primary mathematics lesson. This also corroborates the warning given by Stigler and Baranes (1988) to the effect that teacher must be ready to give more time to planning this type of lesson.

5.1.7: Pre-service Primary Mathematics Teachers' Difficulties in Utilization of Activity-Based lesson Plan

This study found that those exposed to TDAS faced difficulties in the area of motivating students; presenting pupils/teachers activities; in-depth understanding of the subject matter; assessment of learning during teaching and taking decision on the next action to be taken. Those exposed to PABIS had difficulties in one area, which is, deciding the next step of action.

The finding that those exposed to TDAS faced difficulties in motivating pupils at the beginning of a lesson, in having an in-depth understanding of the subject matter, in assessing pupils' learning and in taking decision regarding the next step of action to take could be as a result of the fact that these areas of lesson presentation could not be explicitly demonstrated. This implies that though these pre-service teachers saw their lecturer presenting several lectures, they were not able to observe the reason behind most of the activities carried out by the lecturer during training. Worst still, they had no opportunity to practice these skills, hence, they were unable to demonstrate them (the skills) when they were teaching. This finding corroborates the submission of scholars such as Akinbote (1999), Cruickshank, Jenkins and Metcalf (2003), Khazanov (2007) who argued that a teacher could only teach the way he was taught. The finding that these pre-service teachers were unable to present pupils' and corresponding teacher's activities can perhaps be put down to the fact that this aspect of lesson delivery requires high level of thinking and creativity. However, since they were not allowed to engage in such thinking and activities during the treatment, they found it difficult to demonstrate the skill when they had the opportunity to present primary mathematics lessons. Again, this is in line with the fact that teaching skills must be acquired through activities and not by memorization. Zeichner and Tabachnick (1981), Brouwer (1989), Stofflett and Stoddart (1994) and Korthagen and Kessels (1999), for example, argued that teachers' conceptions of teaching subject matter is strongly influenced by the way in which they themselves learnt this subject content. They have shown that student teachers who themselves experienced learning in an active way are more inclined to plan lessons that facilitate students' active knowledge construction.

The finding that the pre-service teachers exposed to PABIS have difficulties in only the area of taking decision on the next step of action could be as a result of the fact that despite the fact that this set of teachers were exposed to several activities they carried out during the treatment, they were not allowed to deliver a lesson. They were involved only in lesson planning. Therefore, these teachers had no opportunity of taking such decisions. Again, they were unable to observe such actions from their lecturer because, most of the time, lecturers take such decisions outside the lecture room. This could have accounted for the low performance of pre-service teachers exposed to PABIS in the area of taking decisions about the next step of action after teaching. This aspect of lesson presentation as carried out in this study, relied more on theory than practice; therefore, the teachers were unable to transform it into practice. This is in line with the submission of Corporaal (1988), who argued that the poor transfer of theory to practice is as a result of lack of integration of the theories presented in teacher education (the teacher educator's theory) into the conceptions pre-service teachers bring to the teacher education programme (the student teachers' theory). Korthagen and Russell (1995) supported this idea by saying that many teacher education programmes still reflect the traditional "application-of-theory model".

5.1.8: Effect of Treatment on Pre-service Teachers Utilization of Activity-based Primary Mathematics Lesson

The second phase of this study investigated the extent to which the pre-service teachers involved in this study would be able to present activity-based primary mathematics lesson. It was found that those exposed to PABIS had the highest activity-based lesson presentation mean score, followed by those exposed to TDAS while those exposed to conventional strategy had the least mean score. Therefore, the treatment given had a great influence on the activity-based lesson presentations of the pre-service teachers. This finding is slightly different from what happened in phase-1, that is, at the lesson planning stage. It was those exposed to TDAS that had the highest activity-based lesson planning score. However, at the lesson presentation stage, it was those exposed to PABIS that had the highest score.

The finding that those exposed to PABIS acquired activity-based primary mathematics lesson presentation skills more than the other two groups could be as a result of the fact that they were the only group that was exposed to pupils-centred active mathematics learning. They were made to learn primary Mathematics actively wherein they did not only listen and observe, but also explored materials as well as the teaching/learning processes. In this case, they experienced all it takes to present such lesson. This finding corroborates the submission of Rieg and Wilson (2009) who argued that one attempt to revitalise undergraduate education is by shifting pedagogy to a learner-centred focus and supporting an emphasis on the scholarship of teaching and learning. Many other scholars have also advocated learner-centred method of teaching in teacher preparation. Some of these are Filene (2005), Harris and Cullen (2008), Masikunis, Panayiotidis and Burke (2009), Rieg and Wilson (2009), Alexander, Van Wyk, Bereng and November (2009) and Finkel (2000).

The finding that pupil-centred activity-based instructional strategy is the best strategy for producing teachers that could deliver activity-based primary mathematics lesson compared to any other teacher-centred method is in line with Masikunis, Panayiotidis and Burke's (2009) idea that that an effective teaching cannot be attained by transmission model (lecture method) which is characterised by students sitting in rows, facing the lecturer who is considered as 'the sage on the stage'. It can only give a surface approach to learning and no deep understanding could take place. It also supports Filene's (2005) belief that at this level of education (higher education), students have grown up expecting or even demanding more than a 'talking head'. To this end, Akinbote (1999), and Cruickshank, Jenkins and Metcalf (2003) argued that the modified lecture method has one disadvantage that makes it inappropriate for pre-service teachers: it has a significant negative influence on the way the pre-service teachers teach the younger ones. The finding also supports the two factors identified by Finkel (2000) as being responsible for the failure of lecture method: (1) the lecturer presumes students have had experiences that they have not had and (2) reflection is done by the lecturer not by the students. Alexander, Van Wyk, Bereng and November (2009) also argued that Learners' cognitive faculties were thus not engaged, resulting in what was termed 'rote drilling, memorization or cramming'.

The finding that teacher-centred instructional strategies are less effective in preparing primary mathematics teacher is in line with the submission of Korthagen and Kessels (1999) that the traditional didactic approach contradicted the essential nature of Mathematics. According to them, Mathematics is not "a created subject" to be transferred to children, but "a subject to be created". Therefore, this finding should be seen as significant indeed.

5.1.9: Effect of Numerical Ability and Gender on Pre-service Teachers Utilization of Activity-based Primary Mathematics Lesson

This study also investigated the influence of the two moderator variables (numerical ability and gender) on the pre-service teachers' delivery of activity-based primary mathematics lesson. It was found that neither numerical ability nor gender had significant influence on pre-service teachers' delivery of primary mathematics activity-based lesson. The reason for this could be that the teaching process required more of skills of 'know how' than knowledge of mathematical facts and rules. Besides this, the strategy used to train these teachers relied more on activities than on memorization of facts and rules. With these, the pre-service teachers with low background in primary Mathematics were able to perform well and both sexes were also able to perform as expected. However, this finding (that numerical ability has no significant influence on teaching) seems a contradiction to the submission of Raths and Roy (2005) to the effect that knowledge of subject matter is an important prerequisite to effective teaching. There are two ways to explain this: first, if theoretical mathematics teaching is in question, the submission of Raths and Roy might be correct, but that is not tested in this study. Secondly, if activity-based mathematics teaching is in question, the new finding of this study contradicts that of Raths and Roy.

The finding that gender has no significant influence on pre-service teachers' delivery of activity-based teaching is in the direction of the finding of Wong and Lai (2006) that female student-teachers taught better than male student-teachers. Actually, the expectation was that male teachers would teach better than female teachers. To this end, the finding that there was no significant difference between male and female teachers in their delivery of activity-based primary mathematics lesson is in tandem with Wong and Lai's finding and not a total contradiction. Therefore, the finding should be seen as significant.

5.1.10: Effect of treatment on Academic Achievement of Pre-service Teachers in Primary Mathematics Methodology Courses.

In teacher training institutions, an effective instructional strategy should be the one that is capable of imparting both the Pedagogical Content Knowledge (PCK) and the Subject Matter Knowledge (SMK) (Menon, 2009). This study also considered this by investigating the impact of the treatment on the academic achievement of the pre-service teachers in the Primary Mathematics Methodology Course (PES 122). This was done in order to have insight into the effect of the activity-based strategies on the Subject Matter Knowledge (SMK) of the pre-service teachers. This study found that those pre-service teachers exposed to PABIS had the highest academic achievement mean score in PES 122 examination, followed by those exposed to TDAS, but the difference between them was not significant. Those exposed to Conventional Strategy had the least academic achievement mean score in PES 122 and the differences between their score and those in TDAS as well as those in PABIS were significant. In other words, those exposed to activity-based instructional strategies performed significantly better than those exposed to conventional strategy. Therefore, the treatment has a great influence on the academic achievement of the pre-service teachers in primary mathematics methodology course. This finding confirms the claim of Hannaford (2005) that learning by doing creates more neural networks in the brain and throughout the body, making the entire body a tool for learning. Many scholars have tested activity-based instructional strategies, just as done in this study and found them effective in helping learners learn at different levels of education (Sowell, 1989; English and Halford, 1995; Cubey and Dalli, 1996; Fuys et al, 1988; Suydam and Higgins, 1977; Wearne and Hiebert, 1988; Fuson, 1992 and Thompson, 1992). This finding also corroborates the submissions of Sowell (1989) and Richardson (1997) that activity-based instructional strategies are based on constructivist theory which believes that learners are capable of constructing their own knowledge if allowed to interact, explore or be actively involved in the process of learning. It was argued further that these strategies allow individuals to create their own new understandings, based upon the interaction of what they already know and believe and the mathematical idea with which they come into contact. Therefore, this finding is of great importance.

5.2: Summary

This study determined the effects of training programmes on pre-service teachers' acquisition of activity-based primary mathematics lesson planning and utilization skills in Colleges of Education in south west zone of Nigeria. This was considered imperative when it was discovered that graduate teachers from our Colleges can neither plan nor deliver activity-based mathematics lesson at primary school. The effects of two moderator variables, numerical ability and the gender of the pre-service teachers were also investigated.

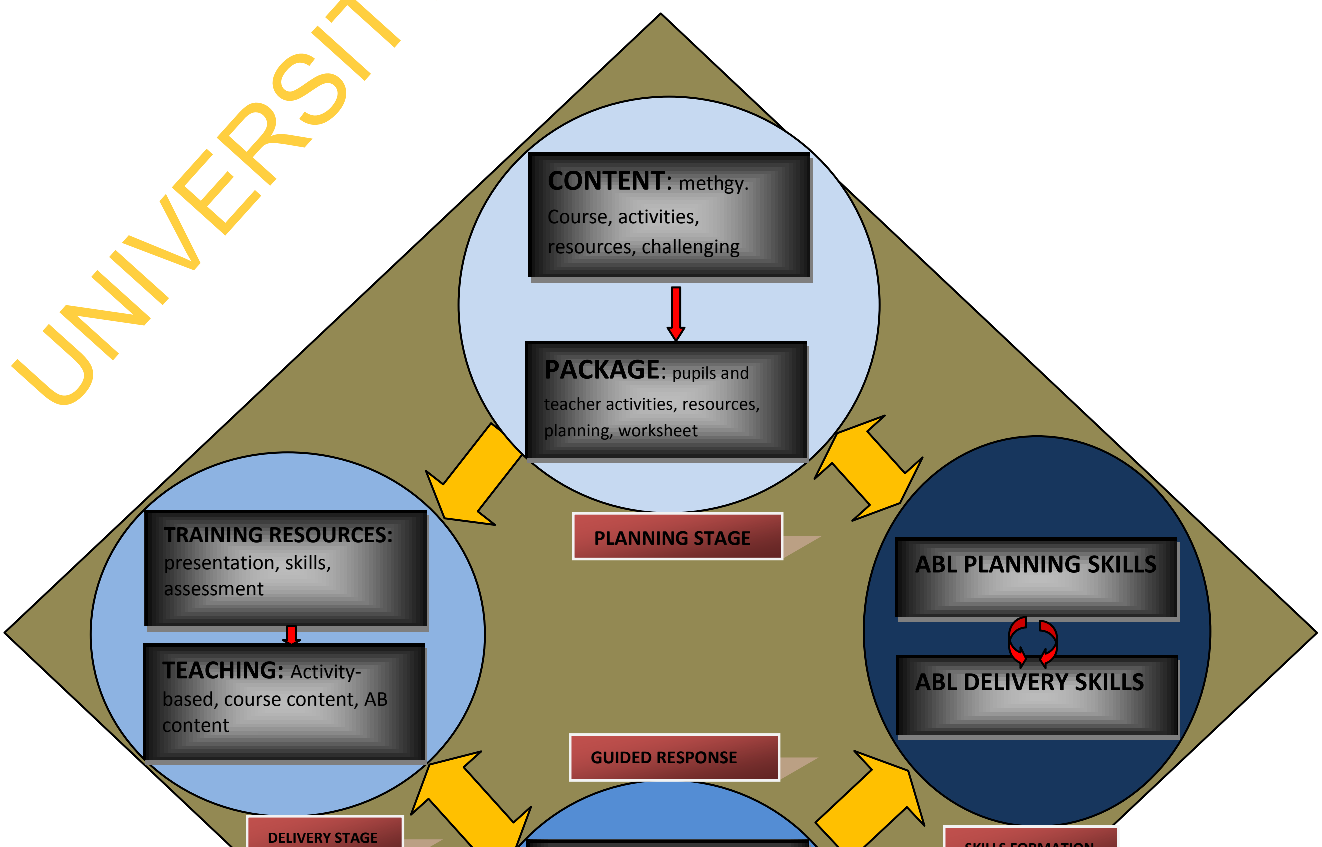
Pretest-posttest, control group quasi-experimental research design was employed to carry out the study in three colleges of education in south west zone of Nigeria. Pre-service teachers offering primary mathematics methodology courses were involved in the 2-phase study that cut across two semesters. Nine research instruments were used to gather data for the study and both descriptive and inferential statistics were used to analyse the data.

The study revealed that those exposed to activity-based instructional strategies planned activity-based primary mathematics lesson better while those exposed to conventional strategy were unable to. Both numerical ability and the gender of the pre-service teachers had no significant effect on the activity-based lesson planning skills acquired by the teachers. Again, those exposed to activity-based instructional strategies delivered activity-based primary mathematics lesson better while those exposed to conventional strategy could not. Numerical ability as well as the gender of the pre-service teachers had no effect on their lesson presentations.

5.3: Conclusion

Based on the findings of this study, it can be concluded that activity-based instructional strategies, that is, pupil-centred activity-based (PABIS) and teacher demonstration instructional strategy (TDAS) are better than modified lecture or direct instruction commonly adopted for the training of primary mathematics teachers in the colleges of education in Nigeria. With the peculiar situation of Nigeria where there are large classes of pre-service teacher, TDAS is more effective in exposing pre-service teachers to the skills of lesson planning while PABIS is more effective in exposing them to activity-based primary mathematics lesson delivery skills. It has also been established that numerical ability and the gender of the pre-service teachers are not strong factors that can hinder their acquisition of activity-based lesson planning and delivery skills. Both the Subject Matter Knowledge (SMK) and the Pedagogical Content Knowledge (PCK) are better acquired when activity-based instructional strategies are employed than when conventional, modified lecture is used. Finally, the teaching of primary mathematics methodology courses in Colleges of Education should include the training of how to plan and deliver activity-based lessons for the pupils on each topic. It seems deficient to teach the pre-service teachers only the SMK and think they will automatically acquire the PCK on their own.

Based on the whole study, a model for activity-based instructions for teacher preparation is proposed. It is believed that the adoption of this model by teacher trainers generally and primary mathematics methodology course lecturers in particular in any institution will produce teachers that will be able to deliver not only activity-based primary mathematics but any other pupil-centred primary instruction.


CONTENT: methgy. Course, activities, resources, challenging
PACKAGE: pupils and teacher activities, resources, planning, worksheet
PLANNING STAGE
TRAINING RESOURCES: presentation, skills, assessment
TEACHING: Activity-based, course content, AB content
ABL PLANNING SKILLS
ABL DELIVERY SKILLS
GUIDED RESPONSE
DELIVERY STAGE

Key

AB = Activity-Based

ABL = Activity-Based Lesson

Fig. 5.1: Activity-Based Instruction Model (ABIM) for Teacher Preparation

Activity-based Instructional Model (ABIM) is a model with 4 major cyclical phases. These are:

i. Planning stage
ii. Delivery stage
iii. Guided response
iv. Skills formation

Planning stage involves two major activities. The first is the identification of course content to be delivered using this instruction. This course must be one of the methodology courses meant for the pre-service teachers. The lecturer must identify the activities that will be carried out by the pre-service teachers as well as the lecturer. These activities must be the ones that will be challenging to students at this level and all the needed resources must be identified. The second activity is to put together the instructional package that will be followed in the course of instruction. Based on the content of the course to be delivered, the learners' activities, lecturer's activities, needed resources, worksheets for classroom activities and take home assignment must be planned and succinctly written down in the package. The successful completion of this package marks the end of phase one and lead to the second phase.

The second phase of the model is called the delivery stage. Here too, there are two levels. The first is the level of training other resource persons that will assist in the delivery of the instruction. This is informed because activity-based instruction for large number of students calls for more than a single hand. The resources persons must be trained on the skills needed for the presentation and assessment of activity-based lesson. After the successful training, the classroom interaction (Teaching) with the pre-service teachers could start. The interaction should feature activities on the course content. Not only this, some content of how to prepare for activity-based instruction must be injected into the instruction. These instructions are expected to last for the whole semester so as to cover the course content.

The third phase has a dual interaction with the second phase. The third phase can only happen after second phase must have taken place; also, if third phase is not well mastered by the learner, then, second phase must be revisited. For instance, if a pre-service teacher should fail the course, he will repeat the class and go through second phase again. This third phase is called guided response stage. This is the stage where individual pre-service teachers will be allowed to demonstrate what they have learnt so far while the lecturer guides their activities. Guided response has three levels: development of individual activity-based lesson plan; lesson plan assessment by the lecturer where in the lecturer closely check the following: material identification, activity suggested, tools and technique of evaluation suggested and domains of learning featuring; finally activity-based lesson delivery and Teaching practise supervision to see how skilful each pre-service teacher can deliver activity-based lesson. This phase leads to the last phase which is called skills formation.

Skills formation has two levels that are interwoven. These are the development of activity-based lesson planning skills and delivery skills. These two skills are formed almost simultaneously. The number of times of phase-three an individual pre-service teacher is able to do, will inform how fast these skills will be mastered. When these skills are well formed, then individual pre-service teachers can now go to phase-one on their own which make it cyclical.

Again, when the teacher try more of phase-one, their skills formation getting better and this will lead to origination in skills development.

It should be noted that this model is propounded using primary mathematics subject. It is believed that the model will be applicable to all other academic fields wherein the teachers are expected to teach using learner-centred instructional strategies. Again, this model is expected to be applicable not only to activity-based strategies only but all other pupil-centred instructions that is expected to be acquired by the primary school teachers.

5.4: Recommendations

The following are recommended as a follow up to the findings of this study:

- Lecturers of primary mathematics methodology courses in the Colleges of Education in south west part of Nigeria should be discouraged from using the conventional method of teaching (modified lecture or direct instruction). Activity-based instructional strategies are better, more effective options that they should be using. This could be achieved by organizing training workshops for them on this. Besides training, NCCE should ensure compliance by setting up a pedagogical monitoring section in each of the states, with trained staff on pedagogy that will supervise the teaching of these courses.

- With activity-based instructional strategies, lecturers of primary mathematics methodology courses should not be concerned so much with the effect of numerical ability or gender of the pre-service teachers. Rather, they should concentrate on developing the creativity skills of the teachers in the area of designing pupils'/teacher's activities that have the mathematical idea explicitly; selection of materials to be used for the activities and how to evaluate the lesson at the end.

- Activity-based instructional strategies are material-driven, hence, each college should ensure that mathematical manipulative materials are adequately provided for the Mathematics Department. This could be achieved by asking the lecturers to make available the list of materials needed and the quantity at the beginning of each session and the college should now provide the fund with adequate supervision. Besides this, the lecturers might be given allowances for mathematical manipulative materials each session and the purchase painstakingly supervised.

- With activity-based instructional strategies, the idea is that there should be a shift from 'reading Mathematics' to 'doing Mathematics'. Therefore, mathematics laboratory should be created in the colleges because the common lecture theatre will not be appropriate. The laboratory is a better place for keeping the manipulative materials and for a sitting arrangement that will ensure group activities, manipulation of materials and free movement of the students than in the common lecture theatre.

5.5: Limitations to the Study

The study was beset with some challenges during the period of field work. The first was the non availability of necessary and appropriate local manipulative materials. Majority of the materials used with the PABIS group were imported from United State of America. The researcher had to make these materials available for the schools during phase-2 of the study when the pre-service teachers were to present activity-based lessons.

The second challenge that this study faced was the effect of industrial strike and students' unrest which elongated the time the phase-2 took place in the schools. The phase-2 stage which should have started in one of the Colleges of Education in the first week of November, 2011, did not commence until the second week of December 2011 because of the student unrest on increment in school fees. In another College of Education, the phase-2 stage which should have commenced by first week of December, 2011 did not start till January, 2012. This was affected by the nationwide strike called by Nigeria Labour Congress (NLC) and Trade Union Congress (TUC) between 9th and 16th January, 2012. This nationwide strike also delayed the start of the phase-2 in one of the colleges and only commenced on the second week of February, 2012. The variation in the time the phase-2 stage started might have a little effect on the data collected.

5.6: Suggestions for Further Studies

The following suggestions are given to whoever will like to replicate this study in the nearest future, especially in other parts of Nigeria:

1. It will be better to start by getting the manipulative materials locally in abundance before starting the fieldwork. This is necessary because the foreign materials might be too expensive. Besides, it is much better to train the teachers with locally made materials they could get easily whenever they want to utilize them.

2. It will also be better to organize the fieldwork outside the school system so as to avoid the strike and unrest that might affect the fieldwork. In other words, some of the lectures might not hold in the school premises but nearby secondary or primary school. Classes might hold on Saturday too. This is not to say the schools should not be used as the basis for the study. But it could be made clear to the participants that the programme is outside their school activities; it is just an intervention to equip them with additional skills. This, in conjunction with refreshment and some token gifts to appreciate the participants, might make them participate to the end.

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Appendix I

PUPIL-CENTRED ACTIVITY-BASED INSTRUCTIONAL PACKAGE (PABIP)

for

Mathematics in Primary Education Studies II (PES 122)

A Stimulus Instructional Package for Doctoral Research Work in the Department of Teacher Education (ECE Unit), University of Ibadan

Developed and produce by

Ishola Akindele **SALAMI**

Under the supervision of

Dr. Ayotola **AREMU**

1st Edition, 2010

Introduction

This package is designed to be used in teaching the course content of PES 122 (Mathematics in Primary Education Studies II), in Colleges of Education. This package is strictly based on activity-based instructional strategy. It is assume that teaching mathematics through activity-based strategy will demystify the learning of the subject.

In this package, there is lesson plan for every topic to be covered; activities to be carried out by the lecturer as well as the pre-service teachers; activity worksheets and the materials to be used are clearly stated. Primary mathematics lecturer using this guide to teach PES 122, is expected to follow this guide religiously, else, s(he) might derailed from activity-based instructional strategy.

It is hope that with this guide, learning primary mathematics, as well as how to teach it, will be fun.

Mathematics in Primary Education Studies II (PES 122, 2 credits, Compulsory Course)

Objectives:

By the end of the course, students (pre-service teachers) should be able to:

- Solve problems on shapes, space and measurement in the primary school Mathematics curriculum,

- Demonstrate competence in the use of variety of methods and strategies (most especially Activity-based instruction) for facilitating the learning of the shapes, space and measurement components of the primary school mathematics curriculum,
- Apply identified strategies (ABL) of measuring shapes space and objects.

Course content:

The under listed content is copied from NCCE 2009 minimum standard as given for PES 122. Table 0.1 below displays some mathematics concepts as given by NCCE 2009 (in the left-hand side) and the same content rearranged for flow of instructions (in the right-hand side). The content are:

- ✓ Modeling and drawing of plane shapes (2D shapes) and methods of teaching it in primary school.
- ✓ Modeling and properties of solid shapes (3D shapes) and methods of teaching it in primary school.
- ✓ Construction of angles and bisection of angles
- ✓ Methodology of non-standard and standard measuring strategies of:

TABLE 0.1: The Given Content by NCCE 2009 and the Rearranged Content to be Used

As Given	**Re-organised**
Capacity	Length
Volume	Perimeter
Perimeter	Area
Length	Volume
Area	Capacity
Mass	Mass (weight)
Money	Money
Time	Time

WEEKLY ACTIVITIES

Week 1: Introduction of the course and administration of pre-test.

Week 2: Modelling and drawing of plane shapes.

Week 3: Modelling 3D shapes.

Week 4: Construction and bisection of angles.

Week 5: Non-standardised and standardised measurement of length and perimeter.

Week 6: Area and administration of attitudinal scale.

Week 7: Volume and capacity of solid shapes.

Week 8: Weight, money and time.

Week 9: Revision and administration of post- test.

ACTIVITY-BASED LESSON PLAN FORMAT

General Information

Subject Area: ……………………………….. Class: ……………… Date ………………………………..

Topic: ……………………………………………… Time: ………………….. Period: …………………

Sub-topic: ……………………………………… Duration: …………………………….

Pre-assessment

Entry Behaviour: ……………………………………………………………………………………… …………………

……………………………………………………………………………………………………… ……………………………………………

Learning Environment:

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…………………………………………….

Resources/Materials:

(1) Already existing

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…………………………………………….

(2) To-be Supplied

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……………..

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…………………………………………….

Behavioural Objectives

Skills:

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…………………………………..

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……………………………………………

Cognitive:

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…………………………..

……
…………………………………………….

Affective:

………………………………………………………………………………………………………

……………………………………………………………………………………………………
…………………………………………….

Classroom Activities

Teacher's activities	Learners' Activities (list)
Motivation:	
Lesson summary:	

Assessment

Tools:

i) ……………………………………………………………………………………………
………………………………………

ii) ……………………………………………………………………………………………
………………………………………

iii) ……………………………………………………………………………………………
………………………………………..

Assessment Areas:

Skills:

……………………………………………………………………………………………………
…………………………………

Cognitive:

………………………………………………………………………………………………………
……………………………

Affective:

………………………………………………………………………………………………………
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Teacher's Reflection on the Lesson

Achievement or otherwise of the objectives:

………………………………………………………………………………

Next step of action:

………………………………………………………………………………………………………
………..

………………………………………………………………………………………………………
……………………………………………..

Effectiveness of teacher's activities:

…………………………………………………………………………………………………

Next step on teacher's activities:

………………………………………………………………………………………………………

………………………………………………………………………………………………………
……………………………………………..

ACTIVITY-BASED LESSON PLAN (Lecture 1)

General Information

Subject Area: PES 122 **Class:** 100 level **Date**: ……………………………….

Topic: Introduction of the course **Time: ………………….. Period: …………………**

Sub-topic: Introduction of the course and administration of the pre-tests.

Duration: 2 hours lecture

Pre-assessment

Entry Behaviour: students are familiar with the name plane geometry, plane shapes and they are familiar with method of teaching as exposed to in EDUC 113 (Principles and methods of Teaching)

Learning Environment: lecture room where there are objects that have plane shapes like sheet of paper, paper money etc and plan shapes in solid shapes like rectangular door etc.

Resources/Materials:

(1) Already Existing: Sheet of paper, pencil, biro etc

(2) To-be Supplied: Typed out course material, plane official sheet of paper and the students' note books.

Behavioural Objectives: By the end of the lesson, students should be able to:

State the title of the course, the course code and some of the course contents

Classroom Activities

Teacher's activities	Learners' Activities (list)
Motivation: lecturer introduces him/her self and the course.	Students listen and possibly note down some points
Lecturer distribute the typed course content to the students	Some of the students help in the distribution of the typed course content
Allow the students to read it for about 3 minutes and pass their comments.	Students read the course content and ask questions or raise suggestions about it
Distribution of plane official sheet of papers to the students and they are asked to prepare **an activity-based lesson plan** on any of the topics in the course content. After that, the teacher say, ***for us to know what area to be emphasised, we need to assess your knowledge in primary maths. So, try your best in the following questions:*** students are given maths ability test to answer.	Students are given 30 minutes to prepare activity-based lesson on any topic of their choice. Students spend the next 25mins to answer the maths ability test.
Collect the prepared lesson plan and the maths ability test and brief the students the kind of lectures they should be expecting. ***The CA of the course is embedded in the class activities; therefore their presence in the lecture is highly necessary.***	Students listen carefully to the lecturer's comments

Group the students into manageable number of groups. The size as well as number of groups depends on the number of students in the class (maximum of 5 students/group).	Students take a number each and form groups as directed by the lecturer. The group is permanent to the end of the course.
Lesson summary: We are planning to have nice time during the PES 122 lectures; we will be learning primary mathematics with fun. Your maximum cooperation is highly needed to make the lectures success. Have a good day.	Students are expected to listen to the instructions.

Assessment

Tools: observation schedule: assign score between 1 and 5 to each of the following statement. 1 represent 'Not at All' and 5 represents 'Large Extent'

i) To what extent do the students work independently to plan the lesson ( )
ii) To what extent do the students demonstrate the understanding of activity-based lesson ( )
iii) To what extent do the students ask questions that they do not know what to do ( )

Assessment Areas:

Skills: Skills of planning activity-based lesson.

Teacher's Reflection on the Lesson

Achievement or otherwise of the objectives: the lecture is just to measure the entry behaviour of the students and to introduce the course to them, so, the set objective is achieved

Next step of action: The teaching through class activities starts full the following lecture**.**

Effectiveness of teacher's activities:
…………………………………………………………………………………….

Next step on teacher's activities:
…………………………………………………………………………………………

……………………………………………………………………………………………………
……………………………………….

ACTIVITY-BASED LESSON PLAN (LECTURE 2)

General Information

Subject Area: PES 122 **Class**: 100 level **Date**: ………………………………….

Topic: Geometry **Time:** ………………….. **Period:** …………………

Sub-Topic: Modelling and drawing plane shapes; method of teaching it at primary school.
Duration: 2 hours

Pre-assessment

Entry Behaviour: Students are familiar with the name; plane shapes, 2D shapes, rectangles squares e.t.c. They can also identify some of the shapes

Learning Environment: Lecture room where plane objects like sheet of paper, cardboard etc and shapes on an objects like rectangular door etc are available

Resources/Materials:

(1) Already existing: sheet of paper, shapes on objects in and around the lecture room.

(2) To-be Supplied: Already-made colourful plane shapes; cardboards, scissors, pencils eraser ruler biro etc. sample of cut out shapes to be discussed (circle, triangles{equilateral, isosceles, scalene, right-angled}; quadrilaterals {rectangles, square, parallelogram, trapezium, rhombus}). One set to a student.

Behavioural Objectives: By the end of the lecture, students should be able to:

Skills: draw, cut out, and use plane shapes in forming pictures (like tangram); plan and deliver activity-based lesson on plane shapes

Cognitive: tell the names, features and differences of at least 8 plane shapes out of about 10 discussed

Affective: justify the use of activity-based teaching to teacher-centred teaching of plane shapes.

Classroom Activities

Teacher's activities	**Learners' Activities (list)**
i) **Motivation:** Greetings. Open the lecture by saying; ***this course shall now commence with the examination of different plane shapes. Now, sit according to your groups***.	Listen to the lecturer for the day's activities; students re-sit according to their groups
Distribution of the materials (cut-out shapes, cardboard, scissors and others brought to the lecture room)	Group leaders assist in the distribution of the materials
Instruct the students to look around them and list at least 7 plane shapes and the object that has the shapes.	Students search their environment and list plane shapes as well as those objects that have the shapes. They are expected to mention: **Triangles** (equilateral, isosceles, right-angled, scalene); **Quadrilateral** (rectangle, square, trapezium, parallelogram and rhombus);

	Circle.
Ask the students to present their findings and lecturer writes it on the board.	Students call out their findings one group after the other.
Ask the question; ***'what make these shapes plane?'*** allow the students to react and then give the answer as; ***'they have no height or thickness'***	Students reflect and supply various responses
Now, draw these shapes on the cardboard given to you, write their names on it then, cut them out like these ones. Teacher show them the ones he brought to the class	Students draw, name and cut out different plane shapes
Shall we now identify the features of the shapes one after the other? (That is, the lines, angles, line of symmetry) Teacher call out the first shape, hold it up and ask the student to hold theirs too. The students are instructed to note the features in their books.	Students hold the shape, look at it and tell the feature that can be observed in it. They also note these features in their note book
Shall we use the little time left to play 'feeling game"? Teacher takes out the game and gives the instruction on how to play it as: ***I.*** ***Dip your hand in the sack [which contain at least 3 pieces of*** **circle, triangles{equilateral, isosceles, scalene, right-angled}; quadrilaterals {rectangles, square, parallelogram, trapezium, rhombus})]** ***and do not look inside.*** ***II.*** ***Pick a shape and feel it for 1min*** ***III.*** ***Tell us the shape you are holding*** ***IV.*** ***Show it to the class.*** ***V.*** ***If you are right, you score one if you are wrong, you score.*** **VI.** ***The person/group with highest score when the shape is exhausted wins***	Students come out one after the order to play the game
Teacher use different types of triangular shapes to form a picture and ask students to try the	Students try to draw various pictures using

same on the worksheet 1 and submit. Teacher also introduce triangle diagram called ‘tangram’	plane shapes.
Finally, what methodologies or instructional strategies have we been using since? Allow students to suggest and finally summarise it by saying. ***The major strategy is activity-based, though other strategies like game and simulation, question and answer were also used.***	Students are expected to call out various instructional methods and strategies.
Assignment ***Try to find out how many line of symmetry has each of the ten plane shapes we discussed by cut-out the shape and fold. Bring all the folded shapes with their line of symmetry to the next class.*** ***Today, we've learnt about various plane shapes, their features and names. When we meet next lecture, we will examine solid shapes. Good day students***	Students are expected to take down the assignment question before dismiss in the lecture room.

Assessment

Tools:

i) Observation schedule
ii) Oral test/questions

Assessment Areas:

Skills: students should be asked to draw, cut out shapes, and use cut out shapes to form objects.

Cognitive: students were asked the following questions orally:

i. Mention 4 types of triangle

ii. Mention four types of equilateral

iii. What are the features of rhombus etc

Affective: students should be asked to identify various shapes in objects in the classroom.

Teacher's Reflection on the Lesson

Achievement or otherwise of the objectives:
………………………………………………………………………….

Next step of action:
……..

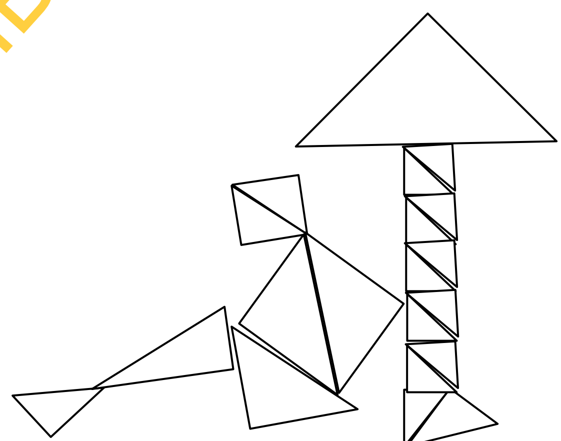
………..

Effectiveness of teacher's activities:
…………………………………………………………………………………………

Next step on teacher's activities:
………………………………………………………………………………………….

……………………………………

LECTURE2 WORKSHEET1



Tangram showing A man sitting down under a tree

ACTIVITY-BASED LESSON PLAN (Lecture 3)

General Information

Subject Area: PES 122 **Class:** 100level**. Date**: ……………………………….

Topic: Geometry **Time: ………………….. Period: …………………**

Sub-topic: Modelling 3D shapes and methods of teaching it at primary school

Duration: 2 hours

Pre-assessment

Entry Behaviour: Students are familiar with plane shapes, the have been seen solid shapes around and they have been hearing names like cube, cuboids, sphere, cylinder etc

Learning Environment: lecture room, in a building block of cuboids shape, and where there a many solid shapes around

Resources/Materials:

(1) Already existing: the building block, the cell phones, the textbooks etc.

(2) To be Supplied: manipulate materials of different solid shapes, cardboard, scissors, ruler, pencil, cellotape and chart showing parts of solids, that is face, edge and vertex.

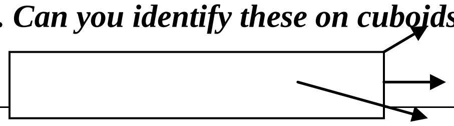
Behavioural Objectives: By the end of this lecture, students should be able to:

Skills: use cardboard to make different solid shapes, both open and closed ones; make some origami; plan and use an activity-based strategy to teach the topic

Cognitive: mention different solid shapes, parts of solid shapes, the net of such shapes and how many plane shapes could form both open and closed of such shape

Affective: justify the need to study solid shapes and their benefits to their environment, show preference for activity-based strategy to teacher-centred teaching of shapes

Classroom Activities

Teacher's activities	Learners' Activities (list)
Motivation: Teacher request for the last take-home activities. ***With all that have been done on plane shapes, there are some shapes that have not been mentioned like***; teacher holds cubiod and ask; ***is this one of the plane shapes? If no what kind of shape is this?***	Students are expected to listen to the lecturer, answer the questions asked. They are expected to mention ***'3D shape/solid shape'***
Teacher instructs the students thus***; Now, let us list the solid shapes that could be seen around us and the respective objects that have such shapes.*** Each group is then asked to present the names of solids they have. These are written on the board. Any shape that is not mentioned is added to it, the ones that are beyond the scope of the course are removed.	Students are expected to list those solid shapes they could think of. Present it to the class. (cuboids, cube, sphere, prism, pyramid, cone, cylinder, tetrahedron {triangular-based pyramid} hemisphere [half-cycle solid] etc)
Teacher now show the students the ready-made solids and ask them to identify, correct them when wrong and also guide them on their thinking.	Students try to identify the solid shapes shown by the teacher, and correct themselves on mistake made
Teacher continues the lecture by saying***; some of these solids have parts called face, edge and vertex. Let us examine these on this chart. Can you identify these on cuboids?*** 	Students are expected to examine the parts as identified on the chart and try to describe them. Again, they are to identify the three parts on the solids provided for their groups and justify their answers.

Let us take out the work sheet2 given to us now and complete the activities. This should led us to a popular theory on relationship among the parts of a solid shape.	Students complete the table in lecture3 worksheet 2.
Let us try and give definition to face, edge and vertex	Students tried to define these terms as the teacher recognises them.
Teacher then give the correct definitions as: ***Face is the flat surface of a solid shape; edge is where two faces meet and vertex is the point where two or more edges meet.***	Students listen and take note of the definitions
To each group, there is one solid made of cardboard, carefully, open the solid to see the plane shapes that make up the solid. Identify the plane shape list how many of the plane make up the solid. Teacher move around to guide the students. The concept of net of open and closed solids is also discussed. **Assignment:** *Find out the following;* *1 does square have vertex?* *2 parts of a sphere and semi-sphere.*	Students open up the solid given to them in their group, identify and count the number of plane shapes that make it up. Students note the assignment questions.
Teacher summarise the lecture and close it	Students dismiss in the class

Assessment

Tools:

i) Observation schedule
ii) Oral questions
iii) Classroom activities

Assessment Areas:

Skills: Drawing, cutting, modelling of solid shapes

Cognitive: Mention the names, parts and net of solid shapes.

Affective: Identification, recognition and description of solid objects in their environment

Teacher's Reflection on the Lesson

Achievement or otherwise of the objectives:

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Next step of action:

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………………………………………..

Effectiveness of teacher's activities:

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Next step on teacher's activities:

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LECTURE3 WORKSHEET2

Name of the shape	Draw the shape	No. of vertices (V)	No. of faces (F)	No of edges (E)	F + V	E + 2
Cubiod						
Cube						
Triangular pyramid						

Rectangular pyramid						

NOTE: 1. Observe the last two columns do you notice any thing? If yes what………

2. Try to generate a theory statement on your observation: ………

3 Who is the first person to discover this fact? ……………………………………………….. (a. Aristotle; b. Euler)

ACTIVITY-BASED LESSON PLAN (Lecture 4)

General Information

Subject Area: PES 122 **Class: 100 level Date**: ……………………………….

Topic: Geometry **Time: ………………….. Period: …………………**

Sub-topic: Construction and bisection of angles **Duration: 2 hours.**

Pre-assessment

Entry Behaviour: Students are familiar with angles

Learning Environment: Lecture room where angles could be identified on real objects.

Resources/Materials:

(1) Already existing: Angles on real objects like, on window frame, on tables and chairs etc.

(2) To-be supplied: Mathematical set, plain paper and card boards, lap-top, projector, internet modem and generator**.**

Behavioural Objectives: By the end of this lecture, students are expected to:

Skills: Use compass, protractor, ruler and pencil to draw, construct, bisect angles; plan and utilize activity-based strategy in teaching construction and bisection of angles

Cognitive: List the steps involved in the construction and bisect of an angle.

Affective: show interest in construction in geometry; appreciate a pupils-centred teaching of the topic.

Classroom Activities

Teacher's activities	learners' Activities (list)
Motivation: ***When we were discussing plane shapes, we mentioned angle. Angle of a given shape determines the correctness of that shape. Take for example, a wall that suppose to make a right angle with the ground, if such makes less than or more than right angle, the building will have problem. The skills of construction and bisection of angles are wonderful.***	Students listen carefully for the days' activities
Now, let your group leaders distribute these materials.	Students distribute the plain papers, mathematical sets, pencil, ruler and other needed materials.
Take out your lecture 4 worksheet 3 paper, study the steps and see if you have question, if not carry out the activity. The teacher move around to guide the students on the activity.	Students study the worksheet and if cleared, carry out the activities on the construction of angle 60^0.
Now, we can also bisect (divide to two equal parts) the angle we have constructed. If we do what would be size of each of the angles we are going to have? (30^0 each)***. Let us go to Lecture 4 Worksheet 4 and do the activities there too.*** The teacher also moves round to guide and facilitate students' activities.	Students take out the Lecture4 worksheet4, read the guide lines and start the activities on bisect of angle 60^0.
Let us go online and do this. Let us visit: **http://www.absorblearning.com/media/item.action?quick=cw**	Students will be guided while individually, the come out to demonstrate on the computer how to bisect angles.

Let us construct angle 90^0 and also bisect it. But first let us generate the guide line for the construction of angle 90^0 together. Teacher guide the students to generate the guidelines and write the guidelines on the board: draw a straight line (which has < 180^0) and identify a point A on it; draw an arc at point A to touch the line at point X and Y; at point X, with a convenient radius on your compass, draw an arc at upper side; with the same radius, move to point Y and draw another arc to cut the first arc at point Z. draw line AZ, the angle ZAX or ZAY must be 90^0 each.	Students raised the guidelines and take to corrections from the teacher when a guidelines is not properly presented.
Let us take a plain sheet and construct and bisect <90^0 on it. **The teacher move around to facilitate and guide the students.**	Students take out a plain sheet, ruler, pencil compass and protractor and construct and bisect angle < 90^0.
Assignment: *at home try and construct and bisect angle 120^0. To be submitted next lecture.*	Students take down the assignment and dismiss in the lecture room.

Assessment

Tools:

i) Observational schedule to observe the students during construction.
ii) Oral questions to see if the students understand the steps in the construction activities

Assessment Areas:

Skills: Drawing, using both compass and protractor to construct.

Cognitive: Ability to explain the steps in the construction and bisect of angles.

Affective: recognition, showing interest in the construction of angles

Teacher's Reflection on the Lesson

Achievement or otherwise of the objectives:

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Next step of action:

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Effectiveness of teacher's activities:

………………………………………………………………………………………………

Next step on teacher's activities:

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LECTURE4 WORKSHEET3

CONSTRUCTION OF ANGLE: Follow these steps to construct angle 60^0

Note that angle 60^0 is an angle in an equilateral triangle (with all sides and angles equal). So, all you need to do is to construct an equilateral triangle by following the steps:

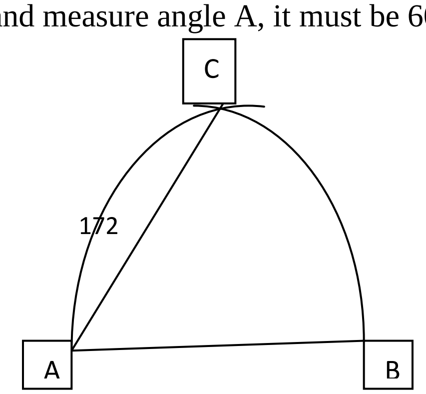
a. Draw a straight horizontal line AB of 6cm.

b. Stretch you compass to a radius 6cm, at point A, make an arc from upper side through point B

c. At point B, with compass of radius 6cm, make another arc from point A to cut the first arc at point C.

d. Draw lines AC and BC. You should have something like the diagram bellow

e. Take out your protractor and measure angle A, it must be 60^0; if not try the activity again.

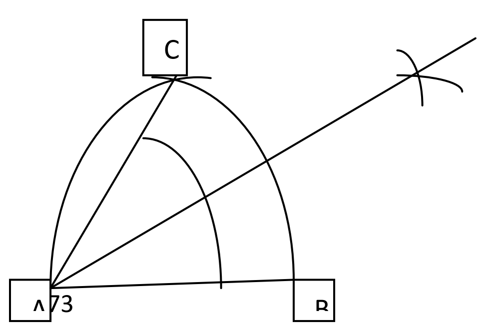


Note that to bisect an angle is to divide it into two equal parts. So, when < 60^0 is bisected, we should have two angles, 30^0 each. Follow these steps and you are done:

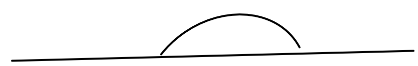
a. Using angle 60^0 you have constructed, make your compass to 3cm. at point A, draw an arc to cut line AC and AB at point M and N

b. At point M, take a convenient radius, make an arc towards the right side. Using the same radius, at point N make another arc to cut the first one at point O.

c. Draw line AO. Measure angle OAB and angle OAC, they must be 30^0 each. Your work should look like this.



Generating guidelines to construct angle 120^0

1. **Do you remember that a straight line has angle 180^0?** 

2. **Do you notice that angle 120^0 is 2/3 (two third) of angle 180^0?**

3. **What would you now do to construct angle 120^0 from angle 180^0? Generate at least four steps:**

    i. ……………………………………………………………………………………
    ………………………………

    ii. ……………………………………………………………………………………
    ………………………………

    iii. ……………………………………………………………………………………
    ………………………………

    iv. ……………………………………………………………………………………
    ………………………………

Then construct the angle (120^0) in the box below:

Topic: Geometry **Time:** ………………….. **Period:** …………………

Sub-topic: Non-standardised and standardised measurement of length and perimeter
Duration: 2 hours

Pre-assessment

Entry Behaviour: students are familiar with distance and length of an object.

Learning Environment: Lecture room where various objects that have length like books, table board, dimension of the room etc are available**.**

Resources/Materials:

(1) Already existing: Various objects in the lecture room that have length and perimeters like books, table tops, lecture-room dimension etc

(2) To be supplied: ruler, string, tape-rule, pencil and recording paper

Behavioural Objectives: by the end of this lecture, students should be able to:

Skills: demonstrate how to measure length/distance using both non-standard and standard measuring tools; plan and utilize activity-based lesson on length and perimeter

Cognitive: explain the advantages of using standard measuring tools over the non-standard ones; approximate to the nearest whole number when non-standard tool is used to measure; find perimeter of both regular and irregular shapes.

Affective: criticise a situation where teaching of measurement is carried out in an abstract way and suggest activity-based strategy for teaching it.

Classroom Activities

Teacher's activities	learners' Activities (list)
Motivation: ***we a moving to something different today. In each group, identify the tallest and the shortest students, then, take out your Lecture5worksheet6. We are to carry out the activity together.***	Students listen to the teacher, identify the tallest and the shortest students in the group, take out the lecture5worksheet6 perform the activities.
Let us discuss our observation in the activity we have just done. Teacher should facilitate the discussion to let the students realise that in activity A the measurement of short and tall students differ while in activity B they are the same. Activity A is when non-standard measurement is used while in activity B standard measurement is used	Students take turn to discuss their observations and findings from the recordings.
Mathematics operations can be performed on lengths i.e. we can add, subtract multiply and divide lengths. For example take out the Lecture5 worksheet7 and let us try activities	Students are to take out the lecture5 worksheet7, study it and carry out the addition, subtraction, multiplication and division of the lengths provided

1.	
Now, if we add up the length around a plane shape, we will arrive at what we called perimeter. If the shape is circle, it will be called circumference. Now, draw one rectangle, square, circle and triangle.	Students get their pencils and plain sheet and draw the shapes while the teacher supervises.
Try and get the perimeter of these shapes except circle by measuring them.	Students start to measure the distance around the shapes, add them up and write down the perimeter of each of them.
Let us try to derive the formula for the perimeter of rectangle and square. **Let us take out our lecture5 worsheet8 and do the activities.**	Students take out the worksheet and perform the activities while the teacher guides.
How do we get the circumference of a circle? Yes, we use rope or string. Take your rope and ruler and let us find out the circumference of the circle in Lecture5 worksheet7 activity 2	Students answer the question and if they cannot, the teacher guides them. Then the find out the circumference of the circle in the worksheet mentioned
So far, we have seen what it takes to measure the length of an object, perform mathematical operation on length and what perimeter means. More importantly, we have seen how to teach this using activity-based strategy. We stop here today and meet on another thing next lecture. Is there any question or reaction so far?	Students listen, ask question if they have any and close for the day.

Assessment Tools:

i. **observation schedule**

ii. **Oral questions**

Assessment Areas:
Skills: drawing, measuring of lengths and perimeters of plane shapes; ability to plan an activity-based lesson on length and perimeter.

Cognitive: ability to find perimeter of regular and irregular shapes; explain the advantages of using standard measurement over non-standard ones.
Affective: demonstrate interest for activity-based teaching to other teacher-centred methods.

Teacher's Reflection on the Lesson

Achievement or otherwise of the objectives:

…………………………………………………………………………….

Next step of action:

………………………………………………………………………………………………………..

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Effectiveness of teacher's activities:

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Next step on teacher's activities:

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LECTURE5 WORKSHEET6

NON-STANDARD AND STANDARD MEASUREMENT

Activity A:

In your group do the following together; while these two students are measuring, others should be recording as well.

Object	**Shortest students**	**Tallest students**
Measure the length of the board with hand span		
Measure the length of the lecture room with foot		
Measure the door frame with your hand span		

What do you notice in the measurement recorded?

Activity B:

In the group let the tallest and the shortest students measure all these objects again with tape rule or ruler and record.

Object	**Shortest students**	**Tallest students**
Measure the length of the board		
Measure the length of the lecture room		
Measure the door frame		

What do you notice in the measurement recorded?

LECTURE5 WORKSHEET7

Mathematics Operations with Lengths

Consider these lines and attempt the questions that follow.

Activities 1:

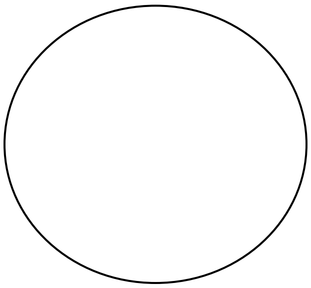
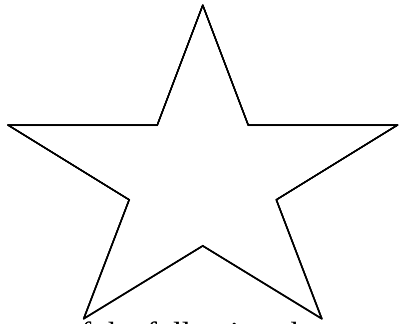
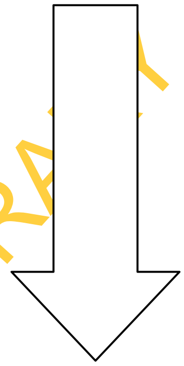
Line A

line B

1. What is the length of line A and that of line B?
2. If I cut the size of line B out of line A, what would be the length of the remaining line of A?
3. If I join line A and B, what will be the length of the new line?

4. How many lines B can we get in line A?
5. If I cut 5 ropes, 3 of which have the length of line A and 2 have the length of line B. What is the total length of these ropes?

Activities 2:

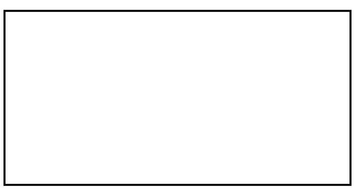
Find the circumference and the perimeter of the following shapes

LECTURE5 WORKSHEET8

Consider the following shapes

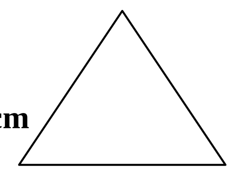
b(cm) **lcm**

a(cm) **ncm**



a(cm)

lcm



b(cm) **lcm** **ocm**

1. **The rectangle** has its length to be ‘b’cm and the breadth to be ‘a’cm. Therefore the perimeter will be: a + b + a + b.

Collect the like terms to have …………………………….

Factorise to arrive at …………………………………….

2. **The square** has its length to be lcm. Since the the 4 sides are equal in length, each will be lcm. Therefore the perimeter will be ………………………………….

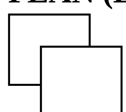
   Factorise this to have ………………………………………

3. **The triangle** has its sides at times equal and at times not equal. To be at a sever side let take the length to be Mcm, Ncm and Ocm. Therefore, the perimeter will be ……………………………………….

   Can this be factorised further? Yes (   ) No (   )

   If yes, write the final answer here ………………………………………………..

ACTIVITY-BASED LESSON PLAN (Lecture 6)



General Information

Subject Area: PES 122 **Class:** 100level **Date:** ……………………………….

Topic: Geometry **Time:** ………………….. **Period:** …………………

Sub-topic: Area **Duration:** 2hrs

Pre-assessment

Entry Behaviour: Students are familiar with plane shapes, perimeter of a shape and they must have been hearing area before now.

Learning Environment: Lecture room where there are various plane shapes like rectangle, square, circle etc

Resources/Materials:

(1) Already existing: Flat table tops, sheet of paper, and other flat objects that have area

(2) To be supplied: Cardboard papers cut into different shapes and sizes; scissors, pencils and papers cello-tape etc

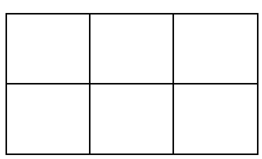
Behavioural Objectives: By the end of the lesson, students should be able to:

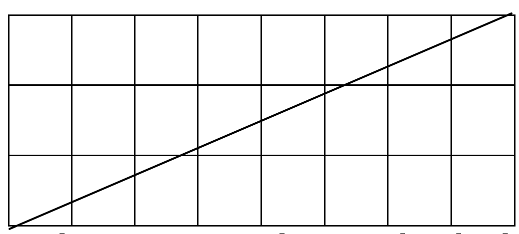
Skills: Plan and utilize activity-based lesson on area of any plane shape in primary mathematics.

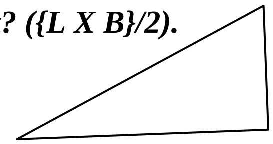
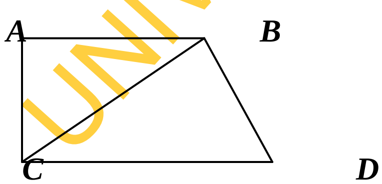
Cognitive: Explain the derivation of the formula of the area of all the plane shapes in primary maths and they will be able to solve mathematical problems about area.

Affective: Show interest in the derivation of the formulae.

Classroom Activities

Teacher's activities	**learners' Activities (list)**
Motivation: Teacher gives a short introduction, ask the students this ***"what did we use to measure length during last lecture? (ruler/tape-rule). What instrument do we use to measure area? (it is assume they might not have the right answer). Alright, let us take out our cardboards, the smaller ones are label 'A' the bigger 'B' and the biggest 'C'. Spread cardboard B and see how many As cardboard will cover the B.***	Students will listen to the instruction and take out the cardboards, they are expected to cover the bigger one with the smaller ones
Teacher asks the following questions: *What is the name of the shape of cardboard 'A'? (square) and 'B'? (rectangle). What is the area of rectangle 'B'? (Number of As that cover it). So, what do we used to measure area now? (square).* ***. Now, on cardboard C, draw a rectangle of 3dm by 2dm, rule it out to look like this:***  ***what is the area of the rectangle?*** *Observe that there are 3 squares of dm dimension at the length and 2 at the breadth*	Students are expected to answer the questions asked by the teacher. When they cannot get any of the question, teacher probe their thought with further questions Students are to rule and draw the rectangle individually, then answer the question ($6dm^2$) reads 'six square decimeter'

This means that there are 6 squares that cover the rectangle and each is of the dimension decimetre. Other squares can be smaller like square centimetre (teacher should show it to the students); bigger ones are ‘square meter’ and ‘square kilometer’ which is used to describe farm land or country/town landscape. Again, let us try more examples. Take out your Lecture6 worksheet9 and do the section A.	*Students are expected to carry out the activities in the worksheet and discover that the area is just the number of squares in the space*.
Observe your last rectangle very well, how can we get the value of the area without counting all the squares? So go to section B of your Lecture6 worksheet 9.	*With close observation after various activities, they should see that multiplying the number of squares in the row by the number in the column should give the answer*.
So, the derivation of the formula of area of a rectangle which in multiplication of the number of squares in the longer side (length) by the number of it in the shorter side (breadth). In symbol: A = L X B. Try this if the area of a rectangle is 24cm ^{2} ***and the breadth is 3cm, what is the length of the rectangle?***	In each group, students are expected to get 24 squares; arrange them in 3s to form a rectangle until the 24 squares are used. They are then expected to count how many columns of 3 squares are formed to make the rectangle. (8 column). This implies the length of the rectangle is 8cm.
In a plain sheet of paper, draw a rectangle 8cm by 3cm. draw a line to cut the rectangle through one of the diagonals. What do you observe?	**Students are expected to draw the rectangle,** draw in it, the diagonal as shown below:  Students are expected to note that the diagonal cut the rectangle into two equal parts and that each part is a triangle.
If we know the area of the rectangle, and we	The students are expected to think and say that

need the area of the triangle, what do we do?	we divide the area of the rectangle into two.
The teacher then questioning thus: so, divide the formula of a rectangle into two to have what? ({L X B}/2).  ***In this triangle, is there L and B? (NO). What do we have instead? (L now turns to Base line and B turns to Height). So, (L X B)/2 can be rewritten as: (B X H)/2. Can you present this in another way? (1/2BH) which reads half base times height.***	Students are expected to answer the teacher's questions and follow the teachers discussion until the formula of area of triangle is derived.
Try the following questions and ready to discuss with us how you get your answers: **a.** ***The half length of a base line of a triangle is 4cm. if the height of the triangle is 5cm, what is the area of the triangle?*** **b.** ***The base line and the height of a triangle is 10cm and 7cm respectively. What is the area of the triangle?*** **c.** ***The area of a triangle is 48cm^2 . If the base line is 80mm, what is the height of the triangle?***	Students are expected to work in groups to solve the problems while the teacher also walks around to monitor the group activities. Any member of the group is called to give answer to any of the question and tell how come.
In the same way, let us draw a trapezium and a line to cut it into two through the diagonal as shown below 	Students are to take their rulers, pencils and plain paper and draw the trapezium with a line cutting it into two through the diagonal.
What do you observe in this shape?	Students are expected to see that the shape has been divided into two triangles.

What is the area of a triangle as derived in this lecture and how many of that do we need to get the area of the trapezium?	Students are expected to answer that it is "half base multiply by height" and that two triangle should give us the trapezium.
Suppose /AB/ = a, the base line for the upper triangle and /CD/ = b, the baseline for the lower triangle. Write out the formula for these two triangles.. Add these two formula together and factorise, what do you get?	Students are expected to write ***1/2ah and 1/2bh respectively*** ***Students are expected to perform this*** ***1/2ah + 1/2bh*** ***1/2h(a + b)which can be re-writing as*** ***½(a + b)h the area of a trapezium.***
Now try these questions in your group and be ready to explain how you come about the answers: ***a. If the parallel sides of a trapezium are 3cm and 6cm and the height of the trapezium is 10cm. what is the area of the trapezium?*** ***b. If the area of a trapezium is 60cm^2 and the two parallel lines are 4cm and 6cm. what is the height of the trapezium.***	Students, with the guide of the teacher are expected to try these problems and solve it. The students are expected to be able to explain how they come about the answers too
At home, study Lecture6 worksheet10 carefully and prepared to answer questions on it. Any question about what we've done so far? After answers have been provided for the questions, the students are given the attitudinal scale to fill.	Students are expected to ask questions and afterwards the teacher closes the lecture. Students are expected to fill the attitudinal scale and submit before leaving the lecture room.
Assignment: work on the derivation of the formula of the area of circle. Use lecture6 worksheet11 to guide your activities. Prepare	Students are expected to take down the assignment questions.

the cut out for submission.	

Assessment

Tools:

i. observation schedule

i) oral questions

Assessment Areas:

Skills: the drawing and observation of the relationships in the drawings

Cognitive: ability to state and apply the formulae of plane shapes.

Affective: ability to derive the formulae and see how one formula leads to the other.

Teacher's Reflection on the Lesson

Achievement or otherwise of the objectives:
………………………………………………………………………………

Next step of action:
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Effectiveness of teacher's activities:
……………………………………………………………………………………………

Next step on teacher's activities:
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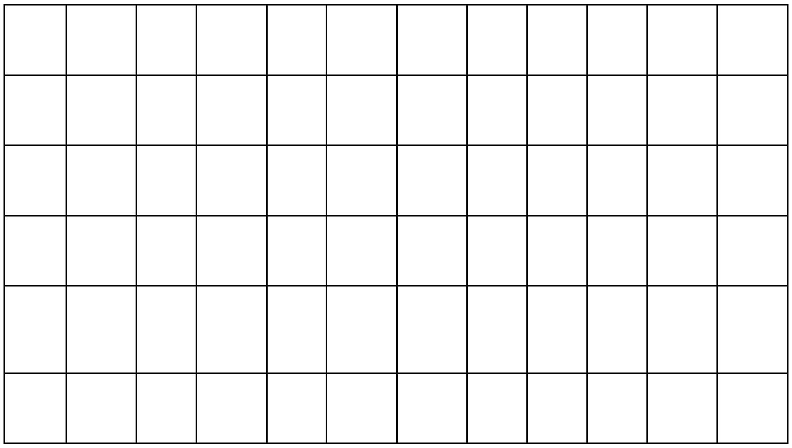
LECTURE6 WORKSHEET9

Section A

Consider the following shapes, do the activities and tell their areas:

A

B



Shape A

1 How many squares in a rows (   )

2 How many squares in a column (   )

3 Multiply number of squares in row and column, the product is (   )

4 Count the number of squares in shape A and tell the area (   )

Shape B

1 How many squares in a rows (   )

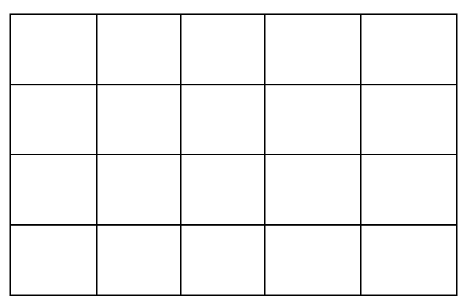
2 How many squares in a column (   )

3 Multiply number of squares in row and column, the product is (   )

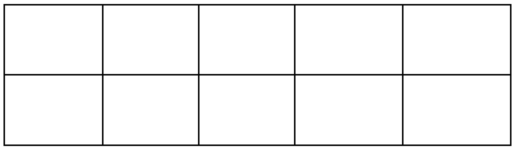
4 Count the number of squares in shape A and tell the area (   )

Section B

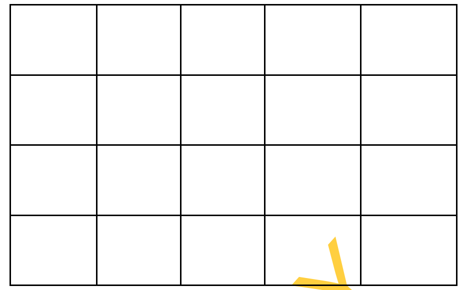
Consider the following shapes again



C



D



Shape C

1 How many squares in a row? (   )

2 How many squares in column? (   )

3 What is the area of the rectangle? (   )

Shape D

1 How many squares in a row? (   )

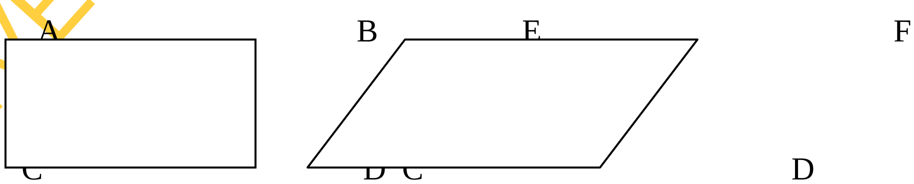
2 How many squares in column? (   )

3 What is the area of the rectangle? (   )

So, how do we get area of a rectangle without counting all the squares? ……….……….

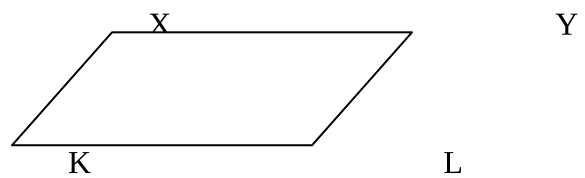
LECTURE6 WORKSHEET10

Activity on Derivation of Area of Parallelogram



- ➢ Observe the shape above; the rectangle ABCD and the parallelogram EFCD.
- ➢ Measure the length and the height of the two shapes, are they the same? Therefore the area covered by the rectangle is the same size covered by the parallelogram. Then, if the area of the rectangle is known, then, the area of the parallelogram is also known.

- Line CD is common to both the rectangle and the parallelogram. What is that line to the rectangle? ……………………………………………
- Line AC or BD is the breadth of the rectangle and it is the height of the parallelogram
- If lines AC and CD are known, what is the area of the rectangle ABCD? ………………………………………………
- If lines AC and CD are known, what is the area of the parallelogram CDEF? …………………………………………………



- Draw a line on the above parallelogram that forms the height of the parallelogram.
- Suppose the line move from X to meet line KL at Z and angle K is θ, using trig ratio, SOH (sin θ= opp/hyp). (opp = XZ = height and hyp = XK = the slant side). Construct a formula for the height. ……
- Now that we have the height of the parallelogram, construct a formula for the area of the parallelogram. ……… .

LECTURE6 WORKSHEET11

Use These Steps to Derive the Formula of Area of a Circle:

Steps:

i. Draw a circle of radius 15cm
ii. Divide the circle to 36 equal sectors as shown here
iii. Cut out the circle as well as the sectors
iv. Re-arrange the sector as show below.

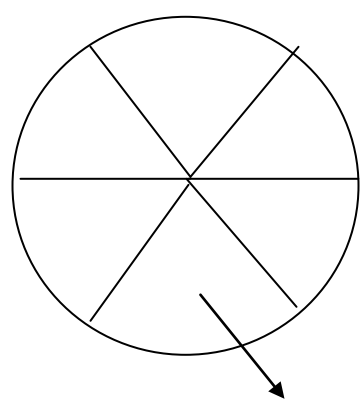
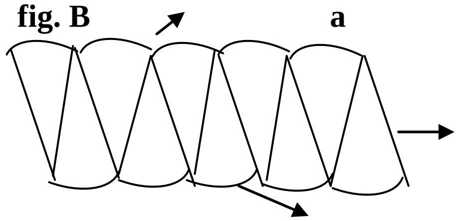


fig. B **a** **fig. A**



A sector

b

c

Note: the number of the sectors facing ‘a’ side should be 18(half of the circumference) and ‘c’ side is also 18 (other half of the circumference); ‘b’ is the radius of the circle.

v. If the total circumference is $2\prod r$, what would side ‘a’ be? ………….., side ‘b’……………. and side ‘c’ ………………

vi. If figure B is a rectangle, using a,b,c; what is the area of the rectangle? ……………………..

vii. Using the value of a, b at step v above, what is the area of the rectangle formed? ………………..

viii. Construct this activities and bring it to the next class.

ACTIVITY-BASED LESSON PLAN (Lecture 7)

General Information

Subject Area: PES 122 **Class:** 100level **Date**: ……………………………….

Topic: Geometry **Time: ………………….. Period: …………………**

Sub-topic: Volume and capacity of solid shapes **Duration:** 2hrs.

Pre-assessment

Entry Behaviour: Students are familiar with solid (3D) shapes and by now they are also familiar with area of plane shapes.

Learning Environment: Lecture room which is more or less a cuboids and where other 3D shapes are available.

Resources/Materials:

(1) Already existing: Lecture room shape and other solids in the lecture room.

(2) To-be supplied: About 10 packs of $60cm^3$; ready-made solid shapes like cuboids, cube, cone, pyramid, prism etc. measuring jar of different sizes and different containers.

Behavioural Objectives: By the end of the lecture, students should be able to:

Skills: build solid shapes with cubes; plan and utilise activity-based lesson on volume and capacity.

Cognitive: Solve mathematical problems on volume and capacity that is not above the level of this course; explain relationships between capacity and volume; state correctly, the formula of volume of at least three plane shapes.

Affective: justify the teaching of volume and capacity through activity-based method;

Classroom Activities

Teacher's activities	learners' Activities (list)
Motivation: ***In our last lecture, we examined how formulae of area of some plane shapes were derived and how we can teach that in an activity way. Today we are going to examine another maths concepts that are related to shapes. Now each group has been given some cubes (60), try to use the cubes to build a cuboids.***	Students first listen to the teacher, then, try to build the cuboids with the cubes given. Possibly with the dimension 3 X 4 X 5.
Each group should tell us the dimension of their cuboids.	Students are expected to count the number of cubes in each dimension and tell the class (3 X 4 X 5; 2 X 5 X 6 etc).
Take the first dimension for instance, what is the 3, 4 and the 5 stand for. Try to build another solid that the dimension will be 3 X 3 X 3, what would the name of the solid be?	Students are expected to answer that; 3 stands for the breadth, 4 for the length and 5 for the height. Afterward, they are expected to build another solid and be able to name it as cube.
Good, the total number of cubes that your	The students are expected to say that the

cuboids shape contains is what we called volume. So, to get volume of a cuboids, what do we need to know?	length, the breadth and the height of the cuboids are needed**.**
The same apply to cube. Volume is measured in cubic mm (mm^3), cubic cm (cm^3), cubic dm (dm^3) cubic m (m^3) etc. what definition can we give to volume now? And what is the formula for volume of cuboids and cube?	Students are to try and define volume on their own as: ***volume is amount of space a solid object has. The formula for volume of cuboids is*** **$V = L \times B \times H$ {$V = L^3$ in case of cube}(reads; volume of a cuboids is the product of its length, breadth and height.)**
Generally, volume **= Base-Area X height.** ***This works for shapes like cylinder, prism. But for pointed shapes like cone; Volume =*** **1/3 X base area X height.** ***Next, take a ruler and measure the dimension of the big cube given to your group, calculate the volume in (cm). Put in it, that powder substance to fill it up, then, pour it into that 1liter jar. What do you observe?***	Students are expected to count, record and compare and observe that the cube is 10 X 10 X 10cm dimension and the volume is $1000cm^3$. Having poured its content into the 1litre jar, they will discover that the volume $1000cm^3$ is equal to 1l capacity.
This shows us that a $1000cm^3$ volume object has the capacity of 1litre.But, let us look around us and list two categories of objects: 1. Those that have volume but no capacity and 2. Those that have both volume and capacity. Get at least three objects foe each category.	Students are expected to look around them and classify the objects into the two categories and present these in the class.
In each group discuss what is to be done to get the volume of a cylinder whose diameter is 4cm and the height is 15cm.	Students are expected to discuss this problem and come to the solution thus**:** ***with the diameter, the basearea can be calculated and then multiplied with the height we give the volume***
Individual student should now calculate the volume of a cone whose base radius 7cm and height 21cm. Teacher should move around to assist guide the students on what to do.	Individual student is expected to calculate this using $V = 1/3 \prod r^2h$ and come out with the answer which is $1078cm^3$.

Assessment

Tools:

i) Observation schedule
ii) Oral question and class works.

Assessment Areas:

Skills: build solid shapes with the $1cm^3$ given during the lecture.

Cognitive: solve for the volume of cylinder, cone etc as given during the lecture.

Affective: why do you think that activity-based method is better used to teach volume and capacity of solids.

Teacher's Reflection on the Lesson

Achievement or otherwise of the objectives:
…………………………………………………………………………………

Next step of action:
………

……

Effectiveness of teacher's activities:
…………………………………………………………………………………………………

Next step on teacher's activities:
………………………………………………………………………………………………………

……

ACTIVITY-BASED LESSON PLAN FORMAT (Lecture 8)

General Information

Subject Area: PES 122 **Class:** 100 level **Date**: ……………………………….

Topic: measurement **Time: ………………….. Period: …………………**

Sub-topic: Weight, Money and Time **Duration:** 2hrs

Pre-assessment

Entry Behaviour: The pre-service teachers are familiar with money, the Nigerian denominations and they have been buying and selling. They are also familiar with concept of time, they have been telling time; ask for time and so on.

Learning Environment: The lecture room where many of the students are with money and wrist washes on them and objects with different weight

Resources/Materials:

(1) Already existing: Wrist washes, Nigerian currency of different denominations; books, chair, table of different weight.

(2) To-be supplied: Nigerian coin, non-working clock, scale.

Behavioural Objectives: By the end of the lecture, students should be able to:

Skills: Draw clock face to show a particular time; measure and record the weight of objects; plan activity-based lesson on money, weight and time.

Cognitive: Carry out calculations that involve weight, money and time; solve mathematical problems on weight, money and time.

Affective: criticise the teaching of time, weight and money through teacher-centred methods**.**

Classroom Activities

Teacher's activities	learners' Activities (list)
Motivation: ***Today, we will be examining the concept of measurement in mathematics. Search your memory and list those things in man's life that are measured and the name of tools used to measure them.***	Students are to list various things that could be measured and the instrument we use to measure them like, height (tape rule), weight (scale), time (clock) etc
That is right. At times, money is also a tool to measure the value of a commodity. Therefore value can also be measured using money. Today, we will be examining only weight, money and time. Let us examine those objects on our table, they are paired. Feel each pair in your hands and record your observation about weight and size in lecture8 worksheet11.	Students are to feel the objects and be able to carry out the activities in lecture8 worksheet11 and answer the questions that follows correctly. (the smaller object has less weight while in the other pair, the bigger object has less weight).

Then, what can you say about size and weight?	Students are expected to say that size does not determine the weight of an object. And discuss this for few minutes.
So when comparing two weights and sizes, how should we say it?	After various responses from the students, they are expected to come up with: for weight, we say 'heavy' 'light' 'heavier' 'lighter' etc. but for size we say 'big' 'small' 'bigger' 'smaller' etc.
Take out your lecture8 worsheet12 and try activity 1. The teacher move around them to guide their activities.	Students are to take out the worksheet and try the activity individually.
After this activity, can someone guess how many grams are there in kilogram?	Students are expected to say that there are 1000grams in a kilogram
You also have some foil money pack for your group, take them out and try to identify the denominations.	Students are expected to bring out the foil money (all Nigerian denominations), they are expected to be able to identify them all including the coins
Now, let's take out the Lecture8 worksheet12 again and try the activity 2. The teacher move around to guide their activities.	Students are expected to start working on the worksheet.
Good job. We have seen the relationship between the money denominations, addition and subtraction of money, profit and loss etc. *Let us examine **Time** now. Each group is given non-working clock. Let us examine it and list on a paper all the parts of the clock.*	Students are expected to listen Students are expected to explore the non-working clock and name all the parts.
Let us take out our Lecture8 worksheet12 and do the activity 3. Teacher is expected to guide the students' activity.	Students are expected to do the activity 3 in the worksheet.
With that activity, we have seen how to add, subtract and solve real life problems about time. ***This semester, we have learnt how to plan and***	Students are expected to ask questions, raise suggestions about primary mathematics and activity-based lesson. Some questions were directed to other students and any one the students cannot answer is answered by the

present primary mathematics lessons in an activity-based form. I hope you enjoy the lesson. The pupils will enjoy it the more if you teach them in the same way. In the next Teaching practicum you are expected to use activity-based lesson to deliver mathematics lesson. Any question or suggestion about what we have done so far?	teacher.
We close the lecture in the next class.	Students dismiss in the lecture room

Assessment

Tools:

i) Observation schedule
ii) Oral question and class works.

Assessment Areas:

Skills: using measuring scale and clock to solve problems**.** Planning and utilizing activity-based lessons on weight, time and money

Cognitive: Calculations in weight, money and time.

Affective: give reasons why you will not use teacher-centred method to teach weight, money and time.

Teacher's Reflection on the Lesson

Achievement or otherwise of the objectives:

…………………………………………………………………………….

Next step of action:

……..

……..

Effectiveness of teacher's activities:

……………………………………………………………………………………………

Next step on teacher's activities:

……………………………………………………………………………………………

……………………………………………………………………………………………………
……………………………………….

LECTURE8 WORKSHEET11

Recording sheet

Pair	**Size**		**Weight**	
	Small	**Big**	**Heavy**	**Light**
First				
Second				

Judgement

1. **Does size determines weight? Yes ( ) no ( )**
2. **Bigger object will surely have heavier weight. Yes ( ) No ( ) not always ( )**
3. **Smaller object could have heavier weight. Yes ( ) No ( ) Not Possible ( )**

LECTURE8 WORKSHEET12

Activity 1: (Group work)

Use the scale provided to solve the following problems:

i. How many objects of 250g do we need to balance the scale having 1kg at one end?

Answer:

……

ii. If there are 3 objects on one side of the scale, 750g, 400g, and 350g. How many objects in kg do will need to balance the scale?

Answer:

……

iii. If the right side of the scale has 2 objects of 4kg and 3kg and the left side has objects of 5kg and 8kg. is the scale balanced? If not what do should I do to balance the scale?

Answer:

……

………..

………..

Activity 2:

Place the foil money on your table before doing these activities:

i. What is 'half a naira' called and what form of the denomination is it?

Answer:

……

ii. How many 'half a naira' do we have in N10 note?

Answer:

……

iii. If Ayo bought the following from a shop: Cornflakes (N250.00k), peak milk (N120.00k), pack of sugar (N180.00k) and collect a change of N150.00k. How much did he give to the seller? What denominations is the money? Can you explain your answer?

Answer: ……

iv. How many ways can you change N1 000 note to 5 smaller denominations (note only) and state the ways:

Answer: ……

………..

v. If I bought 3 motor bicycle at N150 000 and sold each at N65 000, N70 000 and N45 000. Did I gain or lose in the transaction? What is the amount gain and gain percent? (‘Gain percent’ is given by ‘gain/cost prise X 100’).

Answer: ………..

………..

Activity 3:

Use the non-working clock provided to do the following activities:

i. We did 3 activities in today’s lecture. If the first activity took 37mins, the second too 40mins and the third took 13mins. How long did will spend on the whole activities? (Use the clock to add).

Answer: ………..

ii. How many minutes will the minute-hand count for the hour-hand to move from 12 to 2?

Answer: ………..

iii. If Uti spent 1hr 15mins to walk from home to Motor Park, waited for 5min for the bus to move and the bus spent 18mins to get to school at 7:40am. When did Uti left home? (use count back method)

iv. Answer: ………..

ACTIVITY-BASED LESSON PLAN FORMAT (Lecture 9)

General Information

Subject Area: PES 122 **Class:** 100level **Date**: ……………………………….

Topic: Geometry Time: ………………….. Period: …………………

Sub-topic: Revision Duration: 2hrs

Pre-assessment

Entry Behaviour: the pre-service teachers are now familiar with many concepts in geometry.

Learning Environment: The lecture room where many geometrical objects are displayed

Resources/Materials:

(1) Already existing: Wrist washes, Nigerian currency of different denominations; books, chair, table of different weight.

(2) To-be supplied: post-test questions

Behavioural Objectives: By the end of the lecture, students should be able to:

Skills: design an activity based lesson on mathematics.

Cognitive: identify the objectives, materials activities and evaluation tools and areas on a chosen topic.

Affective: .

Classroom Activities

Teacher's activities	learners' activities
So far in PES 122 we have learnt on various contents of primary geometry and methods of teaching this in primary schools. What method would you use to teach geometry in primary school and why?	Students are expected to listen and then answer the question as activity-based method because it allows pupils to learn through hands-on mind-on activities etc
What would you say if a teacher is teaching geometry in primary school using teacher-centred method?	Students are expected to give various answers that shows disadvantages of teacher-centred methods
Why would you recommend activity-based method to other teachers?	Students are expected to give advantages of activity-based method of teaching.
What would make you to do away with activity-based teaching during your TP	Students are to raise challenges that might make them to do away with Activity-based teaching
Now, chose a sub-topic from the course content and plan an activity-based lesson on	Students are expected to spend the next 30mins to plan an activity-based lesson on their

it.	individual topics of interest in mathematics.
Teacher collect the lesson plans and end the lecture	Students dismiss. (End of PES 122).

THE END

Appendix II

ACTIVITY-BASED INSTRUCTIONAL PACKAGE VALIDATION TOOL (ABIPVT)

Introduction: Kindly rate all aspects of the stimulus instrument, ABIP using this tool. Each aspect should be rated on adequacy, appropriateness and if any other comment such as additional item, item to be deleted and so on.
Thanks

Name of Assessor: ……………………………………………………… Lecture: No ……….

S/N	Aspect of ABIP	Adeqt.	Not Adeqt.	Apprt.	Not Apprt.	Specific Comment
1	Topic and sub-topic					
2	Pre- assessment					
3	Resources/material					
4	Beh. objective (cognitive.)					
5	Beh. objective (psychomotor.)					
6	Beh. objective (Affective..)					
7	Teachers activities					
8	Learners activities					
9	Assessment tools					
10	Assess. Area (cognitive.)					
11	Assess. Area (psychomotor.)					
12	Assess. Area (affective.)					
13	Worksheet 1					
14	Worksheet 2					
15	Worksheet 3					
16	Worksheet 4					

Key: **Adeqt.** Means **Adequate; Apprt.** Means **Appropriate**

General Comment:

……
…………………………………………………………………………

Appendix III

TEACHER DEMONSTRATION INSTRUCTIONAL PACKAGE (DIP)

for

Mathematics in Primary Education Studies II (PES 122)

A Stimulus Instructional Package for Doctoral Research Work in the Department of Teacher Education (ECE Unit), University of Ibadan

Developed and produced by

Ishola Akindele **SALAMI**

Under the supervision of

Dr. Ayotola **AREMU**

March, 2011

Introduction

This package is designed to be used in teaching the course content of PES 122 (Mathematics in Primary Education Studies II), in Colleges of Education. This package is strictly based on teacher demonstration instructional strategy. It is assumed that teaching pre-service primary mathematics teachers through demonstration strategy will equipped them with activity-based lesson planning and utilization skills necessary for the teaching of the subject at primary school level.

In this package, there is a lesson plan for every topic to be covered; activities to be carried out by the lecturer and the materials to be used are clearly stated. Any primary mathematics lecturer using this guide to teach PES 122, is expected to follow it religiously, else, s(he) might derail from the demonstration instructional strategy. It is hope that with this guide, the learning and teaching of primary mathematics will be more meaningful.

Mathematics in Primary Education Studies II (PES 122, 2 credits, Compulsory Course)

Objectives:

By the end of the course, students (pre-service teachers) should be able to:

- Solve problems on shapes, space and measurement in the primary school Mathematics curriculum,
- Demonstrate competence in the use of variety of methods and strategies (most especially Activity-based instruction) for facilitating the learning of the shapes, space and measurement components of the primary school mathematics curriculum,
- Apply identified strategies (ABL) of measuring shapes space and objects.

Course content:

The course content listed below is copied from NCCE 2009 minimum standard as given for PES 122. Table 0.1 below displays the mathematics concepts as given by NCCE 2009 (on the left-hand side) and the same content rearranged for proper sequence of instructions (on the right-hand side). The content are:

- ✓ Modelling and drawing of plane shapes (2D shapes) and methods of teaching it in primary school.
- ✓ Modelling and properties of solid shapes (3D shapes) and methods of teaching it in primary school.
- ✓ Construction of angles and bisection of angles
- ✓ Methodology of non-standard and standard measuring strategies of:

TABLE 0.1: The Given Content by NCCE 2009 and the Rearranged Content to be Used

As Given	**Re-organised**
Capacity	Length
Volume	Perimeter
Perimeter	Area

Length	Volume
Area	Capacity
Mass	Mass (weight)
Money	Money
Time	Time

WEEKLY ACTIVITIES

Week 1: Introduction of the course and administration of pre-test.

Week 2: Modelling and drawing of plane shapes.

Week 3: Modelling 3D shapes.

Week 4: Construction and bisection of angles.

Week 5: Non-standardised and standardised measurement of length and perimeter.

Week 6: Area and administration of attitudinal scale.

Week 7: Volume and capacity of solid shapes.

Week 8: Weight, money and time.

Week 9: Revision and administration of post- test.

DEMONSTRATION LESSON PLAN (Lecture 1)

General Information

Subject Area: PES 122 **Class:** 100 level **Date**: ………………………………….

Topic: Introduction of the course (PES 122) **Time: ………………….. Period: …………………**

Sub-topic: Introduction of the course and administration of the pre-tests.

Duration: 2 hours lecture

Pre-assessment

Entry Behaviour: Students are familiar with the name geometry, plane shapes and they are familiar with methods of teaching as exposed to in EDUC 113 (Principles and methods of Teaching)

Resources/Materials:

(1) Already Existing: Sheets of paper, pencil, biro etc

(2) To-be Supplied: Typed out course material, plane sheet of paper and the students' note books.

Behavioural Objectives: By the end of the lesson, students should be able to:

State the title of the course, the course code and some of the course contents

Classroom Activities

Step	**Teacher's Activities**
Step 1	Lecturer introduces him/her self and the course.
Step 2	Lecturer distributes the typed course content to the students
Step 3	Lecturer reads it and allows the students to ask questions or pass their comments.
Step 4	Distribution of plane foolscap sheets of paper to the students and they are asked to prepare **a lesson plan** on any of the topics in the course content. After that, the teacher says, ***for us to know what area to be emphasised, we need to assess your knowledge in primary maths. So, try your best in the following questions:*** students are given numerical ability test to

	answer.
Step 5	Collect the prepared lesson plan and the numerical ability test and brief the students on the kind of lectures they should be expecting.
Step 6	**Lesson summary:** We are planning to have nice time during the PES 122 lectures; we will be learning primary mathematics with fun. Your maximum cooperation is highly needed to make the lectures successful.

Assessment Areas: The following questions are asked after the lesson:

1) What again, is the title of this course?
2) The code of the course is…….? And
3) What are the topics to be covered?

Assignment: None is given.

Teacher's Remark:

………
……..

DEMONSTRATION LESSON PLAN (LECTURE 2)

General Information

Subject Area: PES 122 **Class**: 100 level **Date**: ……………

Topic: Geometry **Time:** ………………….. **Period:** …………………

Sub-Topic: Modelling and drawing plane shapes.   **Duration**: 2 hours

Pre-assessment

Entry Behaviour: Students are familiar with the name; plane shapes, 2D shapes, rectangles squares e.t.c. They can also identify some of the shapes

Resources/Materials:

(1) Already existing: sheets of paper, shapes of objects in and around the lecture room.

(2) To-be Supplied: Already-made colourful plane shapes; cardboards, scissors, pencils, eraser, ruler, biro etc. sample of cut out shapes to be discussed (circle, triangles{equilateral, isosceles, scalene, right-angled}; quadrilaterals {rectangles, square, parallelogram, trapezium, rhombus}). One set to a student.

Behavioural Objectives: By the end of the lecture, students should be able to:

1. draw, cut out, and use plane shapes in forming pictures (like tangram); plan and deliver activity-based lesson on plane shapes
2. mention the names, features and differences of at least 8 plane shapes out of about 10 discussed

Classroom Activities

Step	Teacher's activities
Step1	Open the lecture by saying; ***this course shall now commence with the examination of different plane shapes.***
Step2	Lecturer points to plane shapes or show the students some plane shapes and name them thus: this sheet of paper, naira note is rectangle; this is circle, triangle, square, parallelogram, rhombus, trapezium and kite.
Step3	Ask the question; ***'what make these shapes plane?'*** allow the students to react and then give the answer as; ***'they have no height or thickness'***

Step4	***Lecturer then draws some of these shapes on the board and writes their names on them.*** Teacher show them the ones he brought to the class
Step5	***Shall we now identify the features of the shapes one after the other?*** ***Square, rectangle, triangles, rhombus, circle, trapezium, parallelogram and kite (That is, the lines, angles, line of symmetry)*** Teacher mentions the first shape, holds it up and demonstrate the lines, angles and line of symmetry.
Step6	Teacher uses different types of triangular shapes to form a picture and ask students to observe. Teacher also introduces triangle diagram called 'tangram'
Step7	***Finally, what methodologies or instructional strategies have we been using since?*** Allow students to suggest and finally summarise it by saying. ***The major strategy is demonstration.***
Step8	**Today, we've learnt about various plane shapes, their features and names. When we meet next lecture, we will examine solid shapes.**

Assessment Areas:

1 Students should be asked to identify the plane shapes

2 Students are asked the following questions orally:

iv. Mention 4 types of triangle

v. Mention four types of equilateral

vi. What are the features of rhombus etc

Assignment:

Students should list 5 objects each that have the following plane shape (i) rectangle (ii) circle (iii) right-angled triangle (iv) parallelogram (v) square

Teacher's Remark:

……
………………………………………………………………..

DEMONSTRATION LESSON PLAN (Lecture 3)

General Information

Subject Area: PES 122 **Class:** 100level**. Date**: ……………………

Topic: Geometry **Time: ………………….. Period: …………………**

Sub-topic: Modelling 3D shapes. **Duration:** 2 hours.

Pre-assessment

Entry Behaviour: Students are familiar with plane shapes, they have been seeing solid shapes around and they have been hearing names like cube, cuboids, sphere, cylinder etc

Resources/Materials:

(1) Already existing: the building block, the cell phones, the textbooks etc.

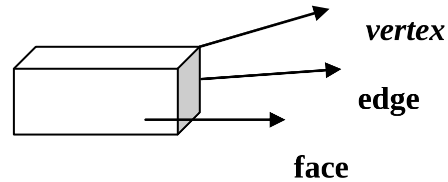
(2) To be Supplied: manipulative materials of different solid shapes, cardboard, scissors, ruler, pencil, cellotape and chart showing parts of solids, that is face, edge and vertex.

Behavioural Objectives: By the end of this lecture, students should be able to:

1. Use cardboard to make different solid shapes, both open and closed ones; make some origami; plan and use an activity-based strategy to teach the topic
2. Mention different solid shapes, parts of solid shapes, the net of such shapes and how many plane shapes could form both open and closed of such shape
3. Justify the need to study solid shapes and their benefits to their environment, show preference for activity-based strategy to teacher-centred teaching of shapes

Classroom Activities

Step	Teacher's activities
Step1	Teacher requests for the last take-home activities. ***With all that have been done on plane shapes, there are some shapes that have not been mentioned like***; teacher holds cuboids and said; ***this is not one of the plane shapes. This is called solid or 3-dimentional shape. Other examples are cube, cylinder, cone pyramid and prism***
Step2	Teacher continues by saying***; Now, I will show you some solid shapes that could be seen around us and the respective objects that have such shapes.*** *lecturer then give the list thus:* cuboids(the building, match box) , cube (dice, sugar cube), sphere (orange ball), prism (bic biro, HB pencil), pyramid (bulding roof), cone, cylinder, tetrahedron {triangular-based pyramid} hemisphere [half-cycle solid] etc

Step3	Teacher now shows the students the ready-made solids and tells them the names of the shapes.
Step4	Teacher continues the lecture by saying**; *some of these solids have parts. Let us examine these on this chart. Lecturer now show the following:*** 
Step5	There is always a relationship between these parts of the solid shape. The sum of vertexes and face is equal to the number of edge plus two. You may check this out. This was first observed by a man called Euler.
Step6	***Let us try and give a definition to face, edge and vertex.*** Teacher then gives the correct definitions as: ***Face is the flat surface of a solid shape; edge is where two faces meet and vertex is the point where two or more edges meet.***
Step7	The teacher then talks about the net of a solid. This he shows by carefully, open the solid to see the plane shapes that make up the solid. Identify the plane shape list, how many of the planes make up the solid.
Step8	Teacher summarises the lecture and then close it.

Assessment

1. Drawing, cutting, modelling of solid shapes

2. Mention the names, parts and net of solid shapes.

3. Recognition and description of solid objects in their environment

Assignment:

Students should be asked to use a cardboard to model any solid shape of their choice and submit next class.

Teacher's Remark:

……………………………………………………………………………………………

…………………………………………………………………..

DEMONSTRATION LESSON PLAN (Lecture 4)

General Information

Subject Area: PES 122 **Class: 100 level Date**: ………………………………..

Topic: Geometry **Time: ………………….. Period: …………………**

Sub-topic: Construction and bisection of angles **Duration: 2 hours.**

Pre-assessment

Entry Behaviour: Students are familiar with angles

Resources/Materials:

(1) Already existing: Angles on real objects like, on window frame, on tables and chairs etc.

(2) To-be supplied: Mathematical set, plain sheets of paper and card boards, lap-top, projector, internet modem and generator**.**

Behavioural Objectives: By the end of this lecture, students are expected to:

1. Use compass, protractor, ruler and pencil to draw, construct, bisect angles; plan and utilize activity-based strategy in teaching construction and bisection of angles

2. List the steps involved in the construction and bisect of an angle.

3. Demonstrate interest in construction in geometry; appreciate a pupils-centred teaching of the topic.

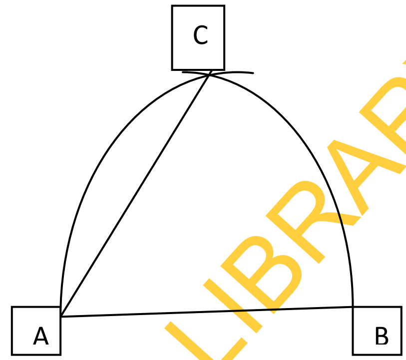
Classroom Activities

Step	Teacher's Activities
Step1	**When we were discussing plane shapes, we mentioned angle. Angle of a given shape determines the correctness of that shape. Take for example, a wall that supposed to make a right angle with the ground, if such makes less than or more than a right angle, the building will not stand straight upright. The skills of construction and bisection of angles are wonderful.**
Step2	Today, we will consider how to construct and bisect angles. Let start by constructing angle 60^0. *Note that angle 60^0 is an angle in an equilateral triangle (with all sides and angles equal). So, all you need to do is to construct an equilateral triangle by following the steps:* I will demonstrate how to do this by following these steps: f. Draw a straight horizontal line AB of 6cm. g. Stretch you compass to a radius 6cm, at point A, make an arc from upper side through point B h. At point B, with compass of radius 6cm, make another arc from point

<table>
<tr><td></td><td>A to cut the first arc at point C.

i. Draw lines AC and BC. You should have something like the diagram bellow

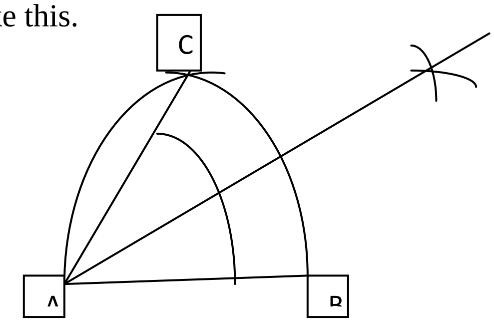
Take out your protractor and measure angle A, it must be 60^0; if not try the activity again.


</td></tr>
<tr><td>Step3</td><td>This angle can also be bisected. To bisect angle 60^0, we should note that to bisect an angle is to divide it into two equal parts. So, when < 60^0 is bisected, we should have two angles, 30^0 each. I will now follow these steps for you to see:

d. Using angle 60^0 I have constructed, I will stretch the compass to 3cm. at point A, draw an arc to cut line AC and AB at point M and N

e. At point M, take a convenient radius, make an arc towards the right side. Using the same radius, at point N make another arc to cut the first one at point O.

f. Draw line AO. Measure angle OAB and angle OAC, they must be 30^0 each. Your work should look like this.


</td></tr>
<tr><td>Step4</td><td>You can learn more on how to construct or bisect angles online. Just visit the web address below. Let us do that together and see. (The lecturer goes to the website on computer system with modem and demonstrate the skills):</td></tr>
</table>

	http://www.absorblearning.com/media/item.action?quick=cw
Step 5	***Let us construct angle 90^0 and also bisect it. But first let us generate the guide line for the construction of angle 90^0 together.*** Teacher guide the students to generate the guidelines and write the guidelines on the board: draw a straight line (which has < 180^0) and identify a point A on it; draw an arc at point A to touch the line at point X and Y; at point X, with a convenient radius on your compass, draw an arc at upper side; with the same radius, move to point Y and draw another arc to cut the first arc at point Z. draw line AZ, the angle ZAX or ZAY must be 90^0 each.
Step 6	***Let us now see how to put the plan in action when I demonstrate the construction. the lecturer take the tool and construct and bisect <90^0 on the board.***

Assessment

1. Drawing, using both compass and protractor to construct.

2. Ability to explain the steps in the construction and bisect of angles.

3. Recognition, showing interest in the construction of angles

Assignment: *At home try and construct and bisect angle 120^0. To be submitted next lecture. Use the worksheet in the next page as guide.*

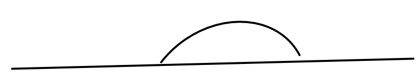
Teacher's Remark:

……………………………………………………………………………………………………

……………………………………………………………………………………………………

WORKSHEET (for lecture 4 assignment)

<u>Generating guidelines to construct angle 120^0</u>

4. **Do you remember that a straight line has angle 180^0?** 

5. **Do you notice that angle 120^0 is 2/3 (two third) of angle 180^0?**

6. **What would you now do to construct angle 120^0 from angle 180^0? Generate at least four steps:**

   v. **………………………………………………………………………………………… ……………………………**

   vi. **………………………………………………………………………………………… ……………………………**

   vii. **………………………………………………………………………………………… ……………………………….**

   viii. **………………………………………………………………………………………… ……………………………….**

Then construct the angle (120^0) in the box below:

Subject Area: PES 122**.** **Class:** 100level **Date**: ……………………………….

Topic: Geometry **Time:** ………………….. **Period:** …………………

Sub-topic: Non-standardised and standardised measurement of length and perimeter
Duration: 2 hours

Pre-assessment

Entry Behaviour: students are familiar with distance and length of an object.

Resources/Materials:

(1) Already existing: Various objects in the lecture room that have length and perimeters like books, table tops, lecture-room dimension etc

(2) To be supplied: ruler, string, tape-rule, pencil and recording paper

Behavioural Objectives: By the end of this lecture, students should be able to:

1. Demonstrate how to measure length/distance using both non-standard and standard measuring tools; plan and utilize activity-based lesson on length and perimeter

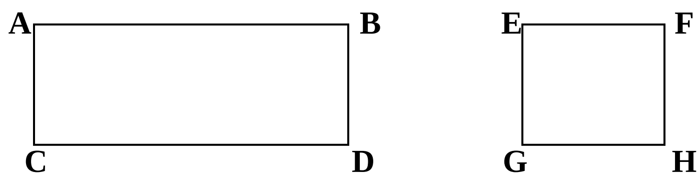
2. Explain the advantages of using standard measuring tools over the non-standard ones; approximate to the nearest whole number when non-standard tool is used to measure; find perimeter of both regular and irregular shapes.

3. Criticise a situation where teaching of measurement is carried out in an abstract way and suggest activity-based strategy for teaching it.

Classroom Activities

Step	Teacher's Activities
Step 1	**We a moving to something different today. I want the tallest and the shortest students in the class to come out. The lecturer put this table on the board and ask the students to carry the activities out and record to their respective position:**

<table>
<tr><td></td><td>
Table A
<table>
<tr><th>Object</th><th>Shortest students</th><th>Tallest students</th></tr>
<tr><td>Measure the length of the board with hand span</td><td></td><td></td></tr>
<tr><td>Measure the length of the lecture room with foot</td><td></td><td></td></tr>
<tr><td>Measure the door frame with your hand span</td><td></td><td></td></tr>
</table>
Table B
<table>
<tr><th>Object</th><th>Shortest students</th><th>Tallest students</th></tr>
<tr><td>Measure the length of the board with tape</td><td></td><td></td></tr>
<tr><td>Measure the length of the lecture room with tape</td><td></td><td></td></tr>
<tr><td>Measure the door frame using tape</td><td></td><td></td></tr>
</table>
Thank the students and ask them to go back to their seats.
</td></tr>
<tr><td>Step 2</td><td>Let us discuss our observation in the activity we have just done. Teacher should facilitate the discussion to let the students realise that in activity A the measurement of short and tall students differ while in activity B they are the same. Activity A is when non-standard measurement is used while in activity B standard measurement is used</td></tr>
<tr><td>Step 3</td><td>Mathematics operations can be performed on lengths i.e. we can add, subtract multiply and divide lengths. Lecturer then demonstrates the activities in Lecture5 worksheet7 on the board.</td></tr>
<tr><td>Step 4</td><td>Now, if we add up the length around a plane shape, we will arrive at what we called perimeter. If the shape is circle, it will be called circumference. Lecturer then brings out already cut-out rectangle, square, circle and</td></tr>
</table>

	triangle.
Step 5	***Lecturer then uses ruler and string to measure and calculate the perimeter of each of these shapes.***
Step 6	***Let us try to derive the formula for the perimeter of rectangle and square.*** **The lecturer present these:**  **In rectangle ABCD, let /AB/ and /CD/ = l and /AC/ and /BD/ = b. then the perimeter P of the rectangle is l + b + l + b** **= l + l + b + b** **= 2l + 2b** **= 2(l + b). [The perimeter of a rectangle].** **Treating the square in the same way but remember the all its sides are equal. So, we have:** **Perimeter of a square = l + l + l + l** **= 4l [perimeter of a square]**
Step 7	***So far, we have seen what it takes to measure the length of an object, perform mathematical operation on length and what perimeter means. More importantly, we have seen how to teach these using materials. We stop here today and meet on another thing next lecture. Is there any question or reaction so far?***

Assessment

1. Drawing, measuring of lengths and perimeters of plane shapes; ability to plan an activity-based lesson on length and perimeter.

2. Ability to find perimeter of regular and irregular shapes; explain the advantages of using standard measurement over non-standard ones.

3. Demonstrate interest for activity-based teaching to other teacher-centred methods.

Assignment:

Get three cyclic objects of different sizes. Get the midpoint of these circles and perform the following operations:

1. Measure the circumferences of these circles and record separately
2. Measure the diameter of the circles and record too
3. Divide the circumference by the diameter of each of the circle and record your answers
4. Note your observation.
5. Take ∏ to be 3.14, multiply this with the diameter of each circle and record.
6. Note your observation.

Teacher's Remark:

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DEMONSTRATION LESSON PLAN (Lecture 6)

General Information

Subject Area: PES 122 ………………………………… **Class:** 100level **Date:**

Topic: Geometry **…………………** **Time: ………………….. Period:**

Sub-topic: Area **Duration:** 2hrs

Pre-assessment

Entry Behaviour: Students are familiar with plane shapes, perimeter of a shape and they must have been hearing area before now.

Resources/Materials:

(1) Already existing: Flat table tops, sheet of paper, and other flat objects that have area

(2) To be supplied: Cardboard papers cut into different shapes and sizes; scissors, pencils and papers cello-tape etc

Behavioural Objectives: By the end of the lesson, students should be able to:

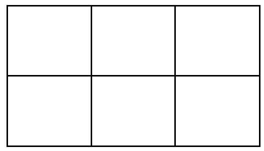
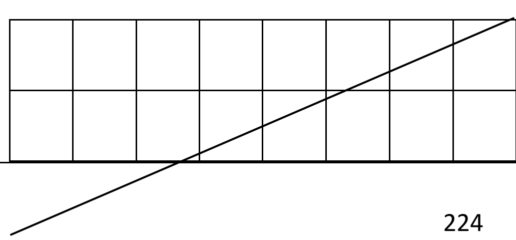
1. Plan and utilize activity-based lesson on area of any plane shape in primary mathematics.

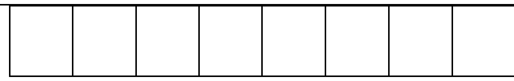
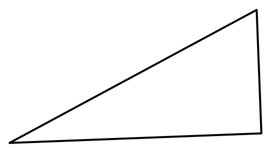
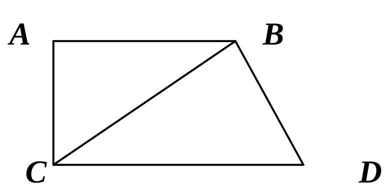
2. Explain the derivation of the formula of the area of all the plane shapes in primary maths and they will be able to solve mathematical problems about area.

3. Show interest in the derivation of the formulae.

Classroom Activities

Step	**Teacher's Activities**
Step 1	Teacher gives a short introduction, asks the students this **"what did we use to measure length during last lecture? (ruler/tape-rule). What instrument is used to measure area? (it is assumed that they might not have the right answer).** Lecturer then takes out cardboards, the smaller ones are label 'A' the bigger 'B' and the biggest 'C'. **Let us see how many of the smallest cardboards (A 1cm^2) will cover the B cardboard.** He spreads cardboard B and arranges pieces of cardboards A on it.
Step 2	Teacher asks the following questions: *What is the name of the shape of cardboard 'A'? (square) and 'B'? (rectangle). What is the area of rectangle 'B'? (Number of As that cover it). So, what have we used to measure area? (square)* **Now, on cardboard C, draw a rectangle of 3dm by 2dm, rule it out to look like this:**

	 **What is the area of the rectangle?** *Observe that there are 3 squares of dm dimension at the length and 2 at the breadth (6dm^2).*
Step 3	***This means that there are 6 squares that cover the rectangle and each is of the dimension decimetre. Other squares can be smaller like square centimetre (teacher should show it to the students); bigger ones are 'square meter' and 'square kilometre' which is used to describe farm land or country/town landscape. Again, let us try more examples. Lecturer draw on the board, a rectangle of 8 by 5 squares.*** ***Observe the rectangle on the board very well, how can we get the value of the area without counting all the squares?*** *(they should see that multiplying the number of squares in the row by the number in the column should give the answer* ***.)***
Step 4	***So, the derivation of the formula of area of a rectangle which in multiplication of the number of squares in the longer side (length) by the number of it in the shorter side (breadth). In symbol: A = L X B.*** ***Try this if the area of a rectangle is 24cm^2 and the breadth is 3cm, what is the length of the rectangle? Let us demonstrate this using cardboards.*** Lecturer is expected to get 24 squares (cm squares); arrange them in 3s to form a rectangle until the 24 squares are used. He then counts how many squares are in the column of the rectangle. (8 squares). This implies that the length of the rectangle is 8cm.
Step 5	***Lecturer draws a rectangle 8cm by 3cm on the board and draws a line to cut the rectangle through one of the diagonals. He then asks the students, what do you observe?*** 

	 (Students are expected to note that the diagonal cut the rectangle into two equal parts and that each part is a triangle). Lecturer shows students a rectangular cardboard, folds it at the diagonal and cut it out to form triangle.
Step 6	***If we know the area of the rectangle, and we need the area of the triangle, what do we do? (***The students are expected to respond that we divide the area of the rectangle into two). ***The lecturer continues thus: so, divide the formula of a rectangle into two to have what? ({L X B}/2).***  ***In this triangle, is there L and B? (NO). What do we have instead? (L now turns to Base line and B turns to Height). So, (L X B)/2 can be rewritten as: (B X H)/2. Can you present this in another way? (1/2BH) which reads half base times height.***
Step 7	**Try the following questions and get ready to discuss/explain how you got your answers:** **d. The half length of a base line of a triangle is 4cm. if the height of the triangle is 5cm, what is the area of the triangle?** e. **The base line and the height of a triangle is 10cm and 7cm respectively. What is the area of the triangle?** f. **The area of a triangle is 48cm^2 . If the base line is 80mm, what is the height of the triangle?**
Step 8	***In the same way, let us draw a trapezium and a line to cut it into two through the diagonal as shown below*** 

	What do you observe in this shape? ***(***Students are expected to see that the shape has been divided into two triangles). ***What is the area of a triangle as derived in this lecture and how many of that do we need to get the area of the trapezium?*** ***(***Students are expected to answer that it is “half base multiply by height” and that two triangles should give us the trapezium.***)***
Step 9	***Suppose /AB/ = a, the base line for the upper triangle and /CD/ = b, the baseline for the lower triangle. To write out the formula for these triangles. We have*** ***1/2ah and 1/2bh respectively.*** ***Add these two formula together and factorise, to get*** ***= 1/2ah + 1/2bh*** ***= 1/2h(a + b)which can be re-writing as*** ***= ½(a + b)h (the area of a trapezium).***
Step 10	***Now try these questions in your group and be ready to explain how you come about the answers:*** a. ***If the parallel sides of a trapezium are 3cm and 6cm and the height of the trapezium is 10cm. what is the area of the trapezium?*** b. ***If the area of a trapezium is 60cm^2 and the two parallel lines are 4cm and 6cm. what is the height of the trapezium.*** **Solution** **a. a=3; b= 6 and h= 10** **using the formula *½(a + b)h*** **= ½ (3 + 6)10cm** **= 9 X 5** **= 45cm^2.** **b.** ***½(a + b)h = 60cm^2***.

	$\frac{1}{2}(4 + 6)h = 60$ **$\frac{1}{2} \times 24h = 60$** **$12h = 60$** **$h = 60/12$** **$h = 5$.**
Step 11	***At home, study Lecture6 worksheet10 carefully and prepared to answer questions on it (lecturer distribute the worksheet). Any question about what we've done so far?*** (After answers have been provided for the questions, the students are given the attitudinal scale to fill).

Assessment:

1: the drawing and observation of the relationships in the drawings

2: ability to state and apply the formulae of plane shapes.

3: ability to derive the formulae and see how one formula leads to the other.

Assignment:

Work on the derivation of the formula of the area of circle. Use lecture6 worksheet11 to guide your activities. Prepare the cut out for submission.

Teacher's Remark:

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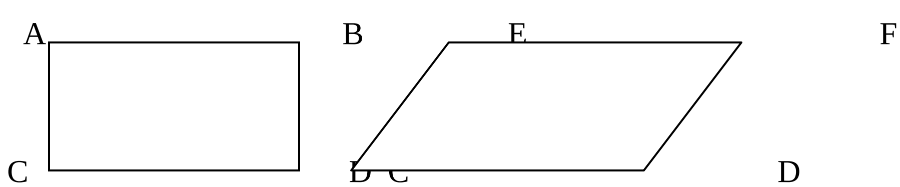
………………………………………………………………………………………………

LECTURE6 WORKSHEET10

Activity on Derivation of Area of Parallelogram



- Observe the shape above; the rectangle ABCD and the parallelogram EFCD.

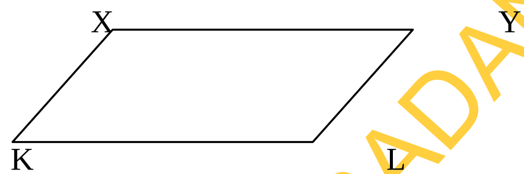
- Measure the length and the height of the two shapes, are they the same? Therefore the area covered by the rectangle is the same size covered by the parallelogram. Then, if the area of the rectangle is known, then, the area of the parallelogram is also known.

- Line CD is common to both the rectangle and the parallelogram. What is that line to the rectangle? ………………………………………………

- Line AC or BD is the breadth of the rectangle and it is the height of the parallelogram

- If lines AC and CD are known, what is the area of the rectangle ABCD? …………………………………………………

- If lines AC and CD are known, what is the area of the parallelogram CDEF? ……………………………………………………



- Draw a line on the above parallelogram that forms the height of the parallelogram.

- Suppose the line move from X to meet line KL at Z and angle K is θ, using trig ratio, SOH ($\sin \theta$= opp/hyp). (opp = XZ = height and hyp = XK = the slant side). Construct a formula for the height. ………

- Now that we have the height of the parallelogram, construct a formula for the area of the parallelogram. ………………………………………………………………………………………………

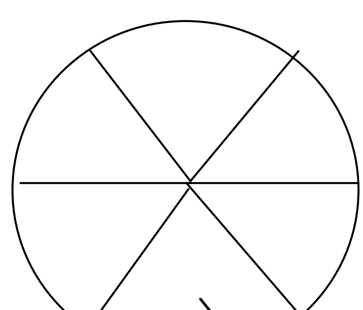
LECTURE6 WORKSHEET11

Use These Steps to Derive the Formula of Area of a Circle:

Steps:

ix. Draw a circle of radius 15cm

x. Divide the circle to 36 equal sectors as shown here

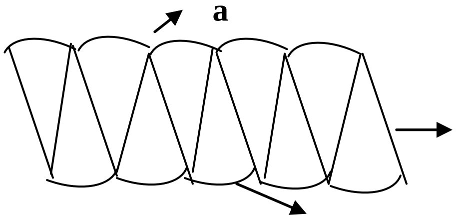


xi. Cut the circle through the lines of the sectors.

xii. Re-arrange the sector as show below.

(*Teacher's demonstration is advised*)

fig. B **a** **fig. A** **A**



sector

b

c

Note: the number of the sectors facing 'a' side should be 18(half of the circumference) and 'c' side is also 18 (other half of the circumference); 'b' is the radius of the circle.

xiii. If the total circumference is $2\prod r$, what would the length of side 'a' be? ………….., side 'b'……………. and side 'c' ………………

xiv. If figure B is a rectangle, using a,b,c; what is the area of the rectangle? …………………….

xv. Using the value of a, b at step vi above, what is the area of the rectangle formed? ………………..

xvi. Construct the circle, cut it out and arranged as explained above and bring it to the next class.

DEMONSTRATION LESSON PLAN (Lecture 7)

General Information

Subject Area: PES 122 **Class:** 100level **Date**: ……………………………….

Topic: Geometry **Time: ………………….. Period: …………………**

Sub-topic: Volume and capacity of solid shapes **Duration:** 2hrs.

Pre-assessment

Entry Behaviour: Students are familiar with solid (3D) shapes and by now they are also familiar with area of plane shapes.

Resources/Materials:

(1) Already existing: Lecture room shape and other solids in the lecture room.

(2) To-be supplied: About 10 packs of 60cm^3; ready-made solid shapes like cuboids, cube, cone, pyramid, prism etc. measuring jar of different sizes and different containers.

Behavioural Objectives: By the end of the lecture, students should be able to:

1. Build solid shapes with cubes; plan and utilise activity-based lesson on volume and capacity.

2. Solve mathematical problems on volume and capacity that is not above the level of this course; explain relationships between capacity and volume; state correctly, the formula of volume of at least three plane shapes.

3. Justify the teaching of volume and capacity through activity-based method;

Classroom Activities

Step	Teacher's Activities
Step 1	**In our last lecture, we examined how formulae of area of some plane shapes were derived and how we can teach this. Today we are going to examine some other maths concepts that are related to shapes. i have with me here some cubes (60), I will now use the cubes to build a cuboids.** (Possibly with the dimension 3 X 4 X 5). There are 3 cubes in the breadth of this cuboids; 4 cubes form the length and 5 cubes form the height. So, how many cubes were used to build this cuboids? (60) that is tha **volume** of the cuboids. Is there any relationship between the dimensions (3,4 and 5) and the volume? (Yes. The product of the dimension is the volume). **Let us build another solid that the dimension will be 3 X 3 X 3, what would the**

	name of the solid be? (cube). **Good, the total number of cubes that your cuboids shape contains is what we called volume. So, to get volume of a cuboids, what do we need to know? (**the length, the breadth and the height of the cuboids)
Step 2	**The same apply to cube. Volume is measured in cubic mm (mm^3), cubic cm (cm^3), cubic dm (dm^3) cubic m (m^3) etc. what definition can we give to volume now? *(volume is amount of space a solid object has.)*** ***What is the formula for volume of cuboids and cube?*** **$V = L \times B \times H$ {$V = L^3$ in case of cube}(reads; volume of a cuboids is the product of its length, breadth and height.)**
Step 3	**Generally, volume = Base-Area X height. This works for shapes like cylinder, prism. But for pointed shapes like cone; Volume = 1/3 X base area X height.** **Let us observe this activity: lecturer takes a ruler and measure the dimension of a big cube he brought to the class (10cm X 10cm X 10cm), calculate the volume in (cm) [1000cm^3]. He Put in it, powder substance that fill it up, then, pour it into a 1liter jar. He then ask the students what they observe?** (the volume 1000cm^3 is equal to 1L capacity**).**
Step 4	**This shows us that a 1000cm^3 volume object has the capacity of 1litre. But, let us look around us and list two categories of objects: 1. Those that have volume but no capacity and 2. Those that have both volume and capacity. Get at least three objects foe each**

	category.
Step 5	**Let us examine some problems. What is to be done to get the volume of a cylinder whose diameter is 4cm and the height is 15cm.** **Solution: (Lecturer work this on the board)** **The volume of a cylinder = base-area X height** **Base-area = $\prod r^2$ (with diameter 4cm, the radius is 2cm)** **Base-area = 3.14 X 2^2 = 12.6$cm^{2.}$ therefore,** **V = 12.6cm^2 X 15cm = 189cm^3.**
Step 6	***Individual student should now calculate the volume of a cone whose base radius 7cm and height 21cm.*** Teacher should move around to assist guide the students on what to do. (Individual student is expected to calculate this using V = 1/3 $\prod r^2h$ and come out with the answer which is 1078cm^3).

Assessment

1. Build solid shapes with the 1cm^3 given during the lecture.

2. Solve for the volume of cylinder, cone etc as given during the lecture.

3. Why do you think that activity-based method is better used to teach volume and capacity of solids.

Teacher's Remark

………………………………..………………………………………………………………………
……………………………………………………………………………………………………….

DEMONSTRATION LESSON PLAN (Lecture 8)

General Information

Subject Area: PES 122 **Class:** 100 level **Date**: ……………………………….

Topic: measurement **Time: ………………….. Period: …………………**

Sub-topic: Weight, Money and Time **Duration:** 2hrs

Pre-assessment

Entry Behaviour: The pre-service teachers are familiar with money, the Nigerian denominations and they have been buying and selling. They are also familiar with concept of time, they have been telling time; ask for time and so on.

Resources/Materials:

(1) Already existing: Wrist washes, Nigerian currency of different denominations; books, chair, table of different weight.

(2) To-be supplied: Nigerian coin, non-working clock, scale.

Behavioural Objectives: By the end of the lecture, students should be able to:

1. Draw clock face to show a particular time; measure and record the weight of objects; plan activity-based lesson on money, weight and time.

2. Carry out calculations that involve weight, money and time; solve mathematical problems on weight, money and time.

3. Criticise the teaching of time, weight and money through teacher-centred methods**.**

Classroom Activities

Step	**Teacher's Activities**
Step 1	***Today, we will be examining the concept of measurement in mathematics. What are those things we do measure and what tools do we use to measure them?*** (e.g, height (tape rule), weight (scale), time (clock) etc) ***At times, money is also a tool to measure the value of a commodity. Therefore value can also be measured using money. Today, we will be examining weight, money and time. Let us examine these objects on the table, they are paired. Feeling each pair in our hands and complete the table below:***

<table>
<tr>
<td></td>
<td>
<table>
<tr><td>Pair</td><td colspan="2">Size</td><td colspan="2">Weight</td></tr>
<tr><td></td><td>Small</td><td>Big</td><td>Heavy</td><td>Light</td></tr>
<tr><td>First</td><td></td><td></td><td></td><td></td></tr>
<tr><td>Second</td><td></td><td></td><td></td><td></td></tr>
</table>
Then, what can you say about size and weight? (size does not determine the weight of an object.)
</td>
</tr>
<tr>
<td>Step 2</td>
<td>So when comparing two weights and sizes, what should we say?

(for weight, we say ‘heavy’ ‘light’ ‘heavier’ ‘lighter’ etc. but for size we say ‘big’ ‘small’ ‘bigger’ ‘smaller’ etc.)</td>
</tr>
<tr>
<td>Step 3</td>
<td>Let us now use the scale provided here to solve the following problems: (Lecturer brings out the scale and the loads).

iv. How many objects of 250g do we need to balance the scale having 1kg at one end?

(Lecturer demonstrates the solution with the materials supplied)

v. If there are 3 objects on one side of the scale, 750g, 400g, and 350g. How many objects in kg do will need to balance the scale?

(Lecturer demonstrates the solution with the materials supplied)

vi. If the right side of the scale has 2 objects of 4kg and 3kg and the left side has objects of 5kg and 8kg. is the scale balanced? If not what do should I do to balance the scale?

(Lecturer demonstrates the solution with the materials supplied)</td>
</tr>
<tr>
<td>Step 4</td>
<td>After this activity, can someone guess how many grams are there in kilogram?(there are 1000grams in a kilogram)</td>
</tr>
<tr>
<td>Step 5</td>
<td>Shall we now examine money as measuring tool. There are some foil money packs here. Try to identify them as I raise them up one after the other. (lecturer raise the foil money up and allow students to identify the denomination).</td>
</tr>
</table>

Step 6	Let us consider the following life-related problems that are related to money: vi. What is 'half a naira' called and what form of the denomination is it? vii. How many 'half a naira' do we have in N10 note? viii. If Ayo bought the following from a shop: Cornflakes (N250.00k), peak milk (N120.00k), pack of sugar (N180.00k) and collect a change of N150.00k. How much did he give to the seller? What denominations is the money? Can you explain your answer? ix. How many ways can you change N1 000 note to 5 smaller denominations (note only) and state the ways: x. If I bought 3 motor bicycle at N150 000 and sold each at N65 000, N70 000 and N45 000. Did I gain or lose in the transaction? What is the amount gain and gain percent? ('Gain percent' is given by 'gain/cost prise X 100'). (Lecturer work together with the students to solve these problems)
Step 7	Let us examine **Time** now. Lecturer brings out the non-working clock and shows the students it various features and how it works**.** Shall we consider the following life-related problems that have to do with time: v. We did 3 activities in today's lecture. If the first activity took 37mins, the second too 40mins and the third took 13mins. How long did will spend on the whole activities? (Use the clock to add). vi. How many minutes will the minute-hand count for the hour-hand to move from 12 to 2? vii. If Uti spent 1hr 15mins to walk from home to Motor Park, waited for 5min for the bus to move and the bus spent 18mins to get to school at 7:40am. When did Uti left home? (use count back method) (lecturer work together with the students to solve these problems)
Step 8	***With that activity, we have seen how to add, subtract and solve real life problems about time.*** **This semester, we have learnt how to plan and present primary mathematics lessons using resources. Your pupils will enjoy the lesson the more if you teach them in the same way. In the next Teaching practicum you are expected to**

	prepare your lessons this way and teach them in the same way. (Lecturer listen and respond to students questions.)

Assessment

1. Using measuring scale and clock to solve problems**.** Planning and utilizing activity-based lessons on weight, time and money

2. Calculations in weight, money and time.

3. Give reasons why you will not use teacher-centred method to teach weight, money and time.

Teacher's Remarks:

………

DEMONSTRATION LESSON PLAN (Lecture 9)

General Information

Subject Area: PES 122 **Class:** 100level **Date**: ………………………………

Topic: Geometry **Time: ………………….. Period: …………………**

Sub-topic: Revision **Duration:** 2hrs

Pre-assessment

Entry Behaviour: the pre-service teachers are now familiar with many concept in geometry.

Resources/Materials:

(1) Already existing: Wrist washes, Nigerian currency of different denominations; books, chair, table of different weight.

(2) To-be supplied: post-test questions

Behavioural Objectives: By the end of the lecture, students should be able to:

1. design an activity based lesson on mathematics.

2. identify the objectives, materials activities and evaluation tools and areas on a chosen topic.

Classroom Activities

Step	Teacher's Activities
Step 1	**So far in PES 122 we have learnt various concepts in primary geometry and methods of teaching this in primary schools. What method would you use to teach geometry in primary school and why? (**Students are expected answer the question and give their reasons).
Step 2	**What would you say if a teacher is teaching geometry in primary school using teacher-centred method? (**Students are expected to give various answers that shows disadvantages of teacher-centred methods)
Step 3	**Why would you recommend resource-based or teacher demonstration method to other teachers? (**Students are expected to give advantages of activity-based method of teaching).
Step 4	**What are the limitations of using resources based- teacher demonstration to teach primary mathematics? (**Students are to raise challenges that might be obstacles to their use of resource-based teacher demonstration during teaching).
Step 5	**Now, chose a sub-topic from the course content of PES 122 and plan a lesson on it.** (Students are expected to spend the next 30mins to plan a lesson on their individual topics of interest in mathematics).
Step 6	**Teacher collects the lesson plans and end the lecture** Students dismiss. (End of PES 122).

The End

Appendix IV

CONVENTIONAL STRATEGY INSTRUCTIONAL GUIDE (CSIG)

For

PES 122 (Mathematics in Primary Education Studies II)

A Stimulus Instructional Package for Doctoral Research Work in the Department of Teacher Education (ECE Unit), University of Ibadan

Developed and produce by

Ishola Akindele **SALAMI**

Under the supervision of

Dr. Ayotola **AREMU**

Mathematics in Primary Education Studies II (PES 122, 2 credits, Compulsory Course)

Objectives:

By the end of the course, students (pre-service teachers) should be able to:

- Solve problems on shapes, space and measurement in the primary school Mathematics curriculum,
- Demonstrate competence in the use of variety of methods and strategies (most especially Activity-based instruction) for facilitating the learning of the shapes, space and measurement components of the primary school mathematics curriculum,

- Apply identified strategies (ABL) of measuring shapes space and objects.

Course content:

- ✓ Modeling and drawing of plane shapes (2D shapes) and methods of teaching it in primary school.
- ✓ Modeling and properties of solid shapes (3D shapes) and methods of teaching it in primary school.
- ✓ Construction of angles and bisection of angles
- ✓ Methodology of non-standard and standard measuring strategies of:

As Given	**Re-organised**
Capacity	Length
Volume	Perimeter
Perimeter	Area
Length	Volume
Area	Capacity
Mass	Mass (weight)
Money	Money
Time	Time

LECTURE 1:

Introduction of the Course and the Measurement of the Entry Behaviour of the Students

Presentation:

Step 1: lecturer introduces him/herself and the course

Step 2: lecturer gives the course content (as highlighted above)

Step 3: lecturer asks the students to prepare an activity-based lesson plan on any of the topic in the content of this course. (This should last for about 20mins).

Step 4: lecturer distributes the mathematics ability test for students to answer (25mins).

Step 5: lecturer collects the lesson plans as well as the test answer sheet and asks if there is any question or reaction

Step 6: lecturer closes the lecture.

LECTURE 2:

Geometry; Modelling and drawing plane shapes.

Step 1: lecturer welcomes the students to the lecture and introduces the topic to be covered as 'modelling and drawing of plane shapes'. *Teaching this topic at primary school should be through activities in order to make the lesson pupils-centred.*

Step 2: lecturer introduces Geometry as: geometry is an aspect of mathematics that deals with shapes and their individual properties. There are two major types of shape in primary maths, these are plane and solid (3-Dimenssion) shapes.

Step 3: Lecturer introduces the plane shapes; their names and draws them on the board. That is, the quadrilateral (rectangle, square, parallelogram, rhombus, kite, trapezium), cycle, triangle (equilateral, isosceles, scalene, right-angled), polygons (pentagon, hexagon, heptagon, octagon, nonagon and decagon) etc.

Step 4: lecturer tells the students what makes the shapes plane as; all these shapes have no thickness or height. That is why they are called plane shapes, some authors called them 2-D shapes because they have only the length and breadth.

Step 5: lecturer gives the features of the plane shapes one after the other

Step 6: the lecture is closed for the day.

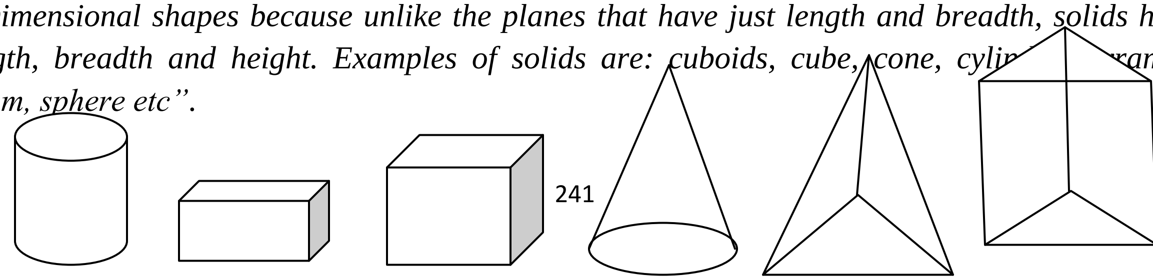
LECTURE 3:

Geometry: Modelling 3D Shapes

Step 1: The lecturer welcomes the students to the class and gives a short revision of the last lecture.

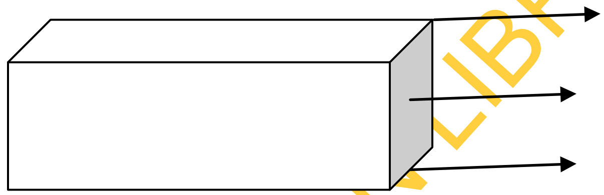
Last lecture, we examined the plane shapes, their names, various types, parts and their net.

Step 2: lecturer introduces the new sub-topic as; "*today, we will be considering the solid shapes. This topic should be taught through activities too. Solid shapes are sometimes referred to as the 3-Dimensional shapes because unlike the planes that have just length and breadth, solids have length, breadth and height. Examples of solids are: cuboids, cube, cone, cylin[illegible]ramid, prism, sphere etc".*



Cylinder cuboids cube cone pyramid prism

Step 3: lecturer give description of solids using cuboids as “*Let us take a closer look at cuboids for example*. (draw a cuboids on the board as shown below)



As shown above, most solids have vertex, face and edge except sphere. The face is the flat part of the solid, the edge is the line that joins two faces while vertex is the point where two or more edges meet. There are exceptional cases to this. For instance, sphere has only round face, no edges no vertex”.

Step 4: Lecturer discuss the net of solids as; “ the net of a solid describes the plane shapes that make up the solid. For example, the cuboids show above can be open-up as shown below:

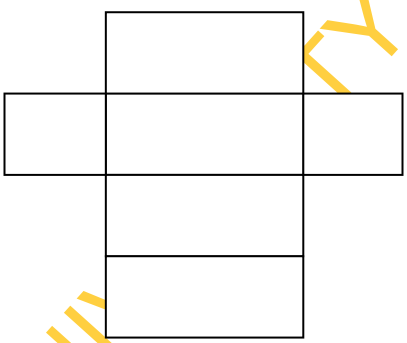


Fig. A

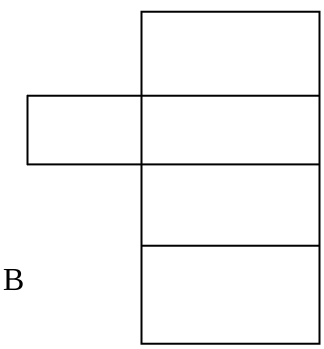
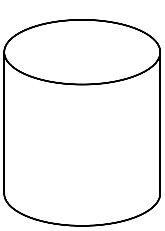
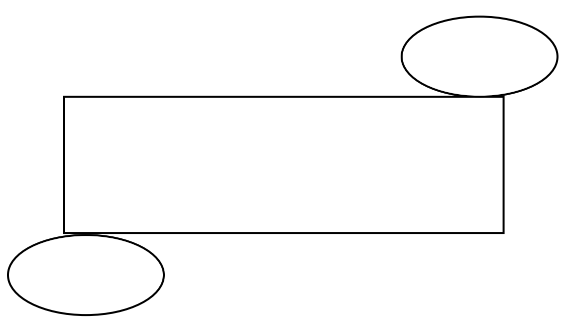


fig. B

Figure A and B above represent the net of closed and open cuboids. Can you spot any difference? Well closed cuboids has 6 rectangles while the open one has 5.

If cylinder, it will look like this





Other solids can also be seen this way too.

Step 5: The lecturer asks if any of the students have question. After this, the lecture is closed for the day.

LECTURE 4

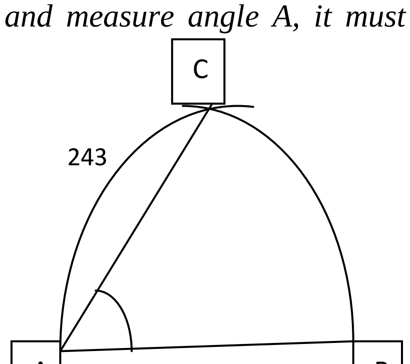
Geometry: Construction and Bisect of Angles

Step 1: Lecturer welcomes the students to the lecture and introduces the new sub-topic as "*today we shall be examining how to construct and bisect angles. For better understanding, you are expected to have the mathematical set instruments like the compass, protractor, ruler and pencil. Remember the teaching should be through activities whenever we are dealing with pupils in primary schools. I am sure you are familiar with what is called an angle*".

Step 2: Construction of angle 60^0

Note that angle 60^0 is an angle in an equilateral triangle (with all sides and angles equal). So, all you need to do is to construct an equilateral triangle by following the steps (lecturer is expected to explain the steps and perform it on the board):

- j. *Draw a straight horizontal line AB of 6cm.*
- k. *Stretch you compass to a radius 6cm, at point A, make an arc from upper side through point B*
- l. *At point B, with compass of radius 6cm, make another arc from point A to cut the first arc at point C.*
- m. *Draw lines AC. You should have something like the diagram bellow*
- n. *Take out your protractor and measure angle A, it must be 60^0; if not try the activity again.*



60^0

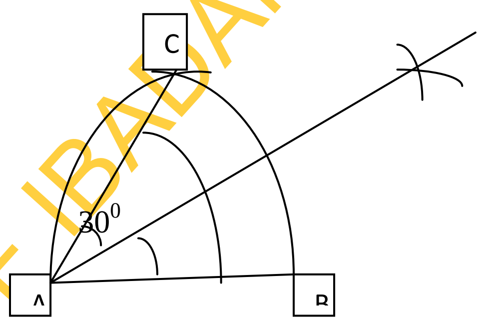
Step 3: Bisect angle 60^0

Note that to bisect an angle is to divide it into two equal parts. So, when < 60^0 is bisected, we should have two angles, 30^0 each. Follow these steps and you are done:

g. *Using angle 60^0 you have constructed, make your compass to 3cm. at point A, draw an arc to cut line AC and AB at point M and N*

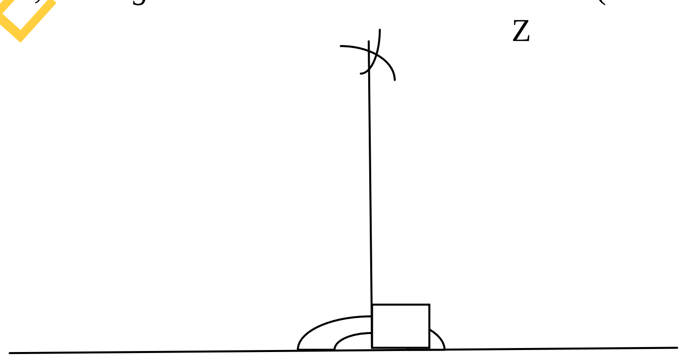
h. *At point M, take a convenient radius, make an arc towards the right side. Using the same radius, at point N make another arc to cut the first one at point O.*

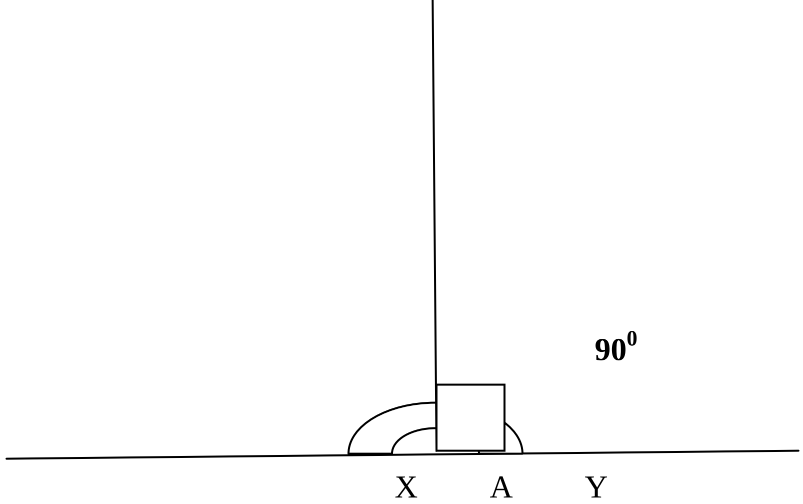
i. *Draw line AO. Measure angle OAB and angle OAC, they must be 30^0 each. Your work should look like this.*



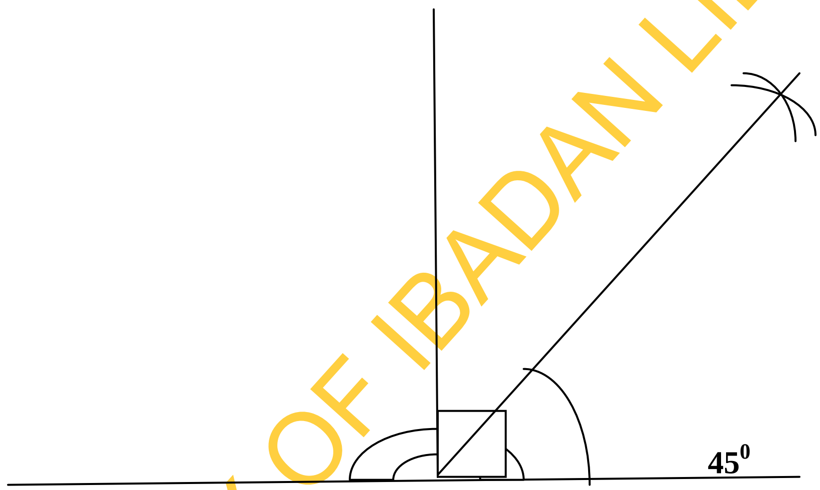
Step 4: Construction of angle 90^0

Let us construct angle 90^0 and also bisect it. *Lecturer writes the guidelines on the board: draw a straight line (which has < 180^0) and identify a point A on it; draw an arc at point A to touch the line at point X and Y; at point X, with a convenient radius on your compass, draw an arc at upper side; with the same radius, move to point Y and draw another arc to cut the first arc at point Z. draw line AZ, the angle ZAX or ZAY must be 90^0 each.* (Lecturer should also construct this on the board)





Step 5: Bisect angle 90^0



At home try and work on how to construct and bisect angle 120^0.

Step 6: lecturer asks if any of the students have question. After, the lecture is closed for the day.

LECTURE 5

Measurement: Non-Standardised and Standardised Measurement of Length and Perimeter; Area

Step 1: The lecturer introduces the lecture by saying; *Good day students. Today, we shall be examining how to teach measurement, the non-standardised and standardised measuring tools. We would also examine the measurement of distance around the shapes of object. So, w will be* *talking about perimeter of plane shapes, circumference of a circle and the possible formula to calculate these concepts.*

Step 2: Let us start the lecture by examining what non-standardized measurement means. *When measuring tools like foot, hand-span, arm-length step-pace and so on to measure, such is said to be non-standardized measurement. The standardized measurement is therefore when measuring tools like ruler, tape-rule etc are used to take measurement. When standardized instrument is used, the measurement is reported in dm, cm, m, km etc. this is widely accepted by everybody unlike the non-standardised on that could be affected by number of factors.*

Step 3: *All mathematical operation can also be performed using standardized measurement. For example***,** *we can add, subtract multiply and divide lengths, weights, times, distances etc. (example could be given)*

Step 4: *Perimeter is known as the distance around a plane shape. When the shape is circle, the distance around it is called circumference. Let us take for example, if a rectangle has its length to be 7cm and the breadth to be 4cm. the perimeter of such rectangle is:*

$= 7 + 4 + 7 + 4$ *(cm).*

$= 22$*cm.*

Perimeter of a rectangle can also be calculated using formula 2(L + B) which reads, two multiplied by the sum of the length and the breadth of the rectangle. Apply this to the example above, to have:

$= 2(7 + 4)$*cm*

$= 2(11)$*cm*

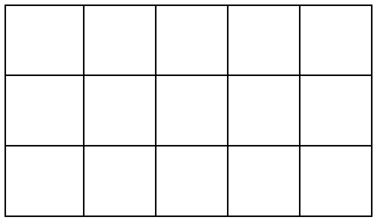
$= 22$*cm*

Other formulae for other plane shapes are:

- *4l for the perimeter of a square*
- *2∏r for the circumference of a circle where r is the radius of the circle*
- *A + B + C for the perimeter of a triangle where A, B and C are the sides of the triangle*

Step 5: *Perimeter/circumference is distinctively different from area, while perimeter/circumference is talking about distance around a plane shape, area deals with the amount of surface covered by the plane shape. That is the reason behind the use of square as the* *tool to measure area. To calculate the area of a rectangle, square parallelogram, circle etc, we arrange smaller squares in the surface of the shape and count the number of the square that cover the surface, so, whenever measurement of area is given, it is always in squares.*

Consider this shape:



The area of the above rectangle is 15squares. If each of the squares is 1cm unit, then the area is 15square cm (shortened as 15cm^2). The following formulae can be used to calculate the area of these respective shapes:

- *L X B for the area of a rectangle where L stands for length and B for breadth.*
- *L^2 for the area of a square*
- *1/2BH; square root of s(s-a)(s-b)(s-c); (1/2absinC or 1/2bcsinA or 1/2casinB) for right-angled triangle, all type of triangle and triangle where 2 sides are given with including angle respectively. Note in the second formula, S= (a + b + c)/2*
- *absinθ where a and b are the slant side and the adjacent side and θ is the including angle.*
- *½(a + b)h for trapezium where a and b are the parallel sides and h is the height.*
- *∏r^2 for circle where r is the radius of the circle.*

Try and study how to apply these formulae. We meet again next week. Good day.

LECTURE 6

Volume and Capacity of Solid Shapes

Step 1: The lecturer start the lecture by saying; *hello students. During the last lecture, we examined the measurement of perimeter and the formula of perimeter of plane shapes; we also* *examined the area of plane shapes. Today, we will be examining the volume and capacity of solid shapes.*

Step 2: *Volume of a solid shape is the amount of space occupied by such solid. That is the hollow space has by the solid to contain object. So, the 'base area' and the 'height' is required to be able to get volume. That is why, for solid like cuboids, the volume is either L X B X H or base area X H. for instance, if the length, breadth and height of a cuboids is 6cm, 4cm and 5cm respectively, the volume of the cuboids is:*

V = 6cm X 4cm X 5cm

= 120cm^3 which reads one hundred and twenty cubic centimetre or

V = Base area X height

Base area is 24cm^2 and the height is 5cm, therefore,

V = 24cm^2 X 5cm

= 120cm^3.

Note that while area is measured in squares, volume is measured in cube. Therefore, it could be cubic millimetre (mm^3), cubic centimetre (cm^3), cubic metre (m^3) etc

Step 3: Other solid shapes have the formulae for their volume as:

- L^3 for the volume of cube where L is the length of the side
- $\prod r^2 h$ *for the volume of a cylinder where r is the radius and h the height.*
- **1/3**$\prod r^2 h$*, 1/3base area X H for the volume of a cone and types of pyramid*
- Base area X Height for prism and so on.

Step 4: *Capacity in the other hand has to do with amount of liquid a solid shape can hold. There are some solid shape that has volume but no capacity while some solids have both volume and capacity. Capacity is measured in litres. Arithmetic operations can be performed on capacities. For example, one can add up, subtract, multiply and divide 5l and 48cl. The relationship between litre and capacity is that 1000cm^3 contains 1litre.*

Step 5: the lecturer close the lecture by ask the students questions afterwards, say, *next class we shall be looking at weight, time and money. Have a good day.*

Lecture 7

Weight, Money and Time

Step 1: The lecturer welcomes the students to the class by saying; good day students. At the close *of last lecture, I said we will be examining three important mathematical concepts today. I hope you can still remember; the weight, money and time. So let us start the class with weight.*

Step 2: *Weight is also known as the mass of an object, it deals with how heavy or light an object is. Weight is measure in gram (milligram, decigram, gram, kilogram etc). What we must know here is the relationship among these units of measuring weight, that is, how many milligram make a decigram; how many gram make a kilogram etc. (search for this information and bring them to the next class) and you should now be able to perform arithmetic operation on weight. For instance, if you divide a kilogram of rice for 4 children, how much rice would a child take? So you are expected to convert from kilogram to gram and be able to divide by 4.*

Step 3: *Teaching money at primary school, one must first teach recognition of different denomination by showing the pupils these. Later one can move to relationship with money (that is, 100kobo make 1naira; two N5s make N10; two N10 make N20; etc) and then, arithmetic operation with money (that is N3 + N5 = N8 etc). Another important thing to be taught under money is the concept of profit and loss; profit and loss percent. This should be performed through activities. Take for instance, (this example should be work on the board):*

If a seller makes a profit of 50% on selling a goat that he bought at N10 000. How much did he sell the goat?

First calculate 50% of N10 000 as:

50/100 X N10 000 = N5 000. Then, add N5 000 to the cost prize to have the selling prize as:

N10 000 + N5 000 = N 15 000. So the seller sold the goat at N15 000, to make 50% profit.

Step 4: *To teach time, teacher must provide a real clock and make-believe clock in the class. These clock will be used to explain the functions of the hands of the clock (the second, minute and hour' hand). After this then, the relationship, conversions between seconds, minutes and hours should be taught. All these should be done using activities.*

Step 5: With this we come to the end of PES 122, any question at this point? (Lecturer should attend to the students questions). Next week, we shall have a short test based on what we have learn in the course. Good day.

Lecture 8

Post test

Step 6: Lecturer should distribute foolscap sheet for the students and ask them to choose a topic of their choice from the ones discussed in this course and plan an activity-based lesson on it. Time allowed is 45mins.

Step 7: Lecturer collects the planned lesson and says, our next meeting will be on the examination day. Be prepared.Wishing you success in the exams.

THE END

Appendix V

ACTIVITY-BASED LESSON PLAN FORMAT

General Information

Subject Area: …………………………………. Class: ……………………………………………….

Topic: ……………………………………………… Date: ……………… Time: …………..
Period: …………

Sub-topic: ……………………………………. Duration: …………………………….

Pre-assessment

Entry Behaviour:
……

………

Learning Environment:
………

……….

Resources/Materials:

(1) Already existing
……

……….

(2) To-be Supplied
………..
…….

Behavioural Objectives

Skills:
………..

………

Cognitive:

……..

……….

Affective:

……

…….

Classroom Activities

Teacher's activities	Pupils' Activities (list)
Motivation	
Lesson summary:	

Assessment

Tools:

i) ……………………………………………………………………………………………………….

ii) ……………………………………………………………………………………………………….

iii) ……………………………………………………………………………………………………..

Assessment Areas:
Skills:
……………………………………………………………………………………………………
…………………………………
Cognitive:
……………………………………………………………………………………………………
………………………….
Affective:
……………………………………………………………………………………………………
……
Teacher's Reflection on the Lesson
Achievement or otherwise of the objectives:
……………………………………………………………………….
Next step of action:
……………………………………………………………………………………………………
………..
……………………………………………………………………………………………………
………………………………………..
Effectiveness of teacher's activities:
…………………………………………………………………………………….
Next step on teacher's activities:
…………………………………………………………………………………………
……………………………………………………………………………………………………
……………………………………….

Appendix VI

PRE-SERVICE TEACHERS ACTIVITY-BASED LESSON PLAN SCALE (PSTABLPS)

PART 1

Institution:
……………………………………………………………………………………………………
……………

Name: ……………………………………………………………………. Matric No.: ……………………………….

Gender: male (   ) female (   )

Course Combination: ………………………………………………………………………………….

PART 2: Behavioural Objectives

Note: 1 = very little; 2 = not much; 3 = very much

s/n	Item	1	2	3
1	Coverage of the 3 domains of the objectives.			
2	Emphasis of the objectives on skill acquisition			
3	Usage of measurable terms for the objectives.			
4	Statement of the Condition of demonstration.			
5	Care for the average learners.			
6	Relationship of the objectives to the sub-topic.			
7	There are more than 1 objectives stated.			
8	Usage of correct grammar to state the objectives.			

PART 3: Resources/Materials Identification

s/n	Item	1	2	3
1	Adequacy of Materials/ resources for the activities.			
2	Capability of Materials/resources in revealing the maths concept.			
3	Appropriateness of Materials/resources to the age of the pupils.			
4	Materials provided can be manipulated by the pupils.			
5	Easy accessibility of Materials/resources.			
6	The ready-made materials are not costly.			
7	Cheap improvisation of the materials.			
8	Materials could be used to teach many maths concepts.			

PART 4: Pupils'/Teacher's Activities

s/n	Item	1	2	3

1	Inclusion of maths concepts in the Activities.			
2	Relationship of activities to the sub-topic.			
3	Sequential ordering of activities.			
4	Logical presentation of activities.			
5	Active involvement of individual child in the activities.			
6	Activities could be completed within the time allocated.			
7	Adequate management of Space during activities.			
8	Activities allow social interaction and communication among pupils.			

PART 5: Assessment Method

s/n	Item	1	2	3
1	Use of varieties of instruments to measure pupils' learning			
2	Appropriateness of the instruments to measure the identified objectives			
3	Extent of content validity of the instruments.			
4	Appropriate allocation of marks for assessment.			
5	The instruments are not difficult to design			
6	Relationship between items in the assessment and the objectives			
7	Coverage of the objectives by the assessment items.			
8	Coverage of more than one learning domains by the assessment items.			

Appendix VII

ACTIVITY-BASED LESSON UTILIZATION SCALE (ABLUS)

Part 1

Name of student: ………………………………………………….. Matric No: …………………………….

Year ………….. Date: ………………………..

School: ………

Subject: ……

Topic: ……

Sub-Topic: ………………………………………………………………… Class: ………………………………………

Part 2

Instruction to Supervisor

Write the score you award for observation during every visitation in the column **"visits".** The total of such scores should be written in the space provided.

Item / Lesson Feature	**Rating**	**visits**				**Average score**	**Remark**
		1	**2**	**3**	**4**		
1 Motivation i) Teacher assessment of the entry behaviour of the pupils. ii) Teacher gets the pupils ready by using a short motivational introduction.	1 2 3 4 5 1 2 3 4 5						
2 Pupils'/Teacher's Activities i) Teacher presents the activities such that all the pupils are actively participating. ii) Teacher guides and facilitates the activities of the pupils. iii) Teacher guides/facilitates the pupils' activities such that the expected learning takes place.	1 2 3 4 5 1 2 3 4 5						

	1 2 3 4 5						
3 Materials i) Teacher provides enough manipulative materials for individual pupil. ii) Appropriateness of materials for the age of the pupils. iii) Materials are relevant to the sub-topic(s).	1 2 3 4 5 1 2 3 4 5 1 2 3 4 5						
4 Subject Mastery i) Teacher shows, through the activities, the in-depth knowledge and application of the topic. ii) Teacher is able to relate 'materials manipulation' to 'mathematical calculation. iii) Teacher is able to relate the mathematical concept to its everyday use.	1 2 3 4 5 1 2 3 4 5 1 2 3 4 5						
5 Classroom Atmosphere i) Teacher, irrespective of pupils' activities, manage the class skilfully to avoid disorganization.	1 2 3 4 5						

ii) Classroom environment is arranged such that it is conducive for the activities. iii) Teacher strategically places other materials that could facilitate pupils learning in the classroom environment.	1 2 3 4 5 1 2 3 4 5						
6 Assessment i) Teacher use appropriate assessment tools during the lesson to measure cognitive domain ii) Teacher use appropriate assessment tools during the lesson to measure Affective domain iii) Teacher use appropriate assessment tools during the lesson to measure Psychomotor domain	1 2 3 4 5 1 2 3 4 5 1 2 3 4 5						
7 Next Step of Action i) Teacher gives out-of-class activity for the pupils.	1 2 3 4 5						
8 Teacher Demeanour i) Teacher participates in the activities in a way to motivate the pupils. ii) Teacher dressing and character worth emulating by the pupils.	1 2 3 4 5						

	1 2 3 4 5						
TOTAL MARKS	**100**						

Special comment (if any) in support of the observation:
…………………………………………………………

……
……
……………………………………………………………………………………………

Name of the supervisor: …………………………………………… signature:
……………………………………………..

Appendix VIII

PRIMARY NUMERICAL ABILITY TEST (PNAT)

PART A

Name: ………………………………………………………………………… **Matric No.**: ………………………………………..

Gender: male (   ) female (   )

Institution: ……….

Best Teaching Subject: ………………………………………………….

PART B

Instruction: Attempt all questions

Q1. The first figure in the set of natural numbers is ……………………………

(A) 1 (B) -1 (C) 0 (D) -0

Q2. Which of the following is an equivalent fraction to 3/5?

(A) 6/15 (B) 9/10 (C) 4/6 (D) 12/20

Q3. Which of the following is a simple fraction?

(A) 6/5 (B) 4/5 (C) 12/27 (D)3/2

Q4. In a town, there are 7, 200, 000 people. If 600 people failed to indicate their gender and the number of males is twice that of female. How many males indicated their gender?

(A) 2 399 800 (B) 7 199 400 (C) 4 799 600 (D)7 200 600

Q5. By how much is 7/9 greater than 1/3?

(A) 4/9 (B) 4/3 (C)11/3 (D)10/9

Q6. The quotient of 843/7 is 120 remainder ………..

(A) 4 (B) 3 (C) 5 (D) 2

Q7. Solve: 1/3 of (11-2) + 6 ÷ 3

(A) 5/3 (B) 5 (C) 3 (D) 4

Q8. Approximate 487 567 to the nearest hundred

(A) 487 000 (B) 487 500 (C) 478 600 (D) 487 600

Q9. What is the value of x in the equation; 7 : 6 = (x + 4) : (x + 3)

(A) 3 (B) -3 (C) 7/6 (D) 4/3

Q10. Express the prime factors of 9 000 in index form

(A) $2^2 \times 3^3 \times 5^3$ (B) $2^3 \times 3^2 \times 5^3$ (C) $3^2 \times 5^3 \times 7^2$ (D) $5^4 \times 7^3$

Q11. A 25 Kg bag of rice is to be shared among 50 people equally. What will be the weight of each person's rice?

(A) 500g (B) 2kg (C) 0.5g (D) 5g

Q12. It took a man 1hr 45mins to walk from his house to a motor park and immediately boarded a bus which traveled for 50mins to get to the destination. If the man left his house at 12mins past 6 in the morning, what time did he arrived the destination?

(A) 2hrs 35mins (B) 8:07am (C) 8: 47am (D) 8:47pm

Q13. A cow seller bought a cow from Kano at N45 000.00k, transportation of the cow from Kano to Ibadan cost N3 800.00k. He later sold the cow at N47 500. What is the percentage loss of the man transaction?

(A) 2.7% (B) 1300% (C) 3% (D) 5%

Q14. A shape with 5 faces (1 square and 4 triangles); 5 vertices and 8 edges is ……………………..

(A) triangular-based pyramid (B) cone (C) square-based pyramid (D) square based prism

Q15. A three sided shape that has a line of symmetry is known as ………………………………..

(A) triangle (B) equilateral triangle (C) isosceles triangle (D) scalene triangle

Q16. Taking ∏ to be 22/7, what is the radius of a circle whose area is $154cm^2$?

(A) 4 (B) 7 (C) 6 (D) 5

Q17. Find a distance round a circle of radius 21cm, what other name can be given to that calculated distance

(A) 132cm; circumference (B) 2772cm; circumference (C) 2772; meter (D)$132cm^2$; circumference

Q18. Consider these scores of 20 pupils in mathematics test:

1, 2, 1, 3, 5, 6, 7, 9, 1, 2, 3, 4, 5, 5, 6, 6, 6, 6, 7, 5

What is the mean score of the pupils?

(A) 5 (B) 4.5 (C) 4 (D) 3

Q19. What is the mode of the scores?

(A) 4.5 (B) 2.5 (C) 6 (D) 5

Q20. What is the median of the pupils' scores?

(A) 5.5 (B) 6 (C) 2.5 (D) 5

Solutions:

1 C

2 D

3 B

4 C

5 A

6 B
7 B
8 D
9 A
10 B
11 A
12 C
13 A
14 C
15 C
16 B
17 A
18 B
19 C
20 D

Table 3.4.1: Table of Specification for PMAT

S/N	Topic	Knowldg.	Comp.	Appl.	Analy.	Synth.	Eval.	Total
1	Number and Numeration		**Q1**	**Q2**	**Q3**			3
2	Basic Operation	**Q7, Q8**	**Q9**	**Q4**	**Q6, Q10**		**Q5**	7
3	Measurement			**Q11, Q13**		**Q12**		3
4	Geometry		**Q17**	**Q16**			**Q14, Q15**	4
5	Everyday Statistics	**Q18, Q19, Q20**						3
	Total	5	3	5	3	1	3	**20**

Appendix IX

ATTITUDE TOWARDS ACTIVITY-BASED LESSON QUESTIONNAIRE (ATABLQ)

Kindly respond to the following items as they best fit your situations.

PART A:

Name: ……………………………………………………………… Matric No.: ………………………………………

Gender: Male (   ) female (   )

Institution: ………

Your Teaching Subject: ……………………………………………………………………

PART B:

Note: SD is Strongly Disagree; D is Disagree; A is Agree and SA is Strongly Agree.

S/N	STATEMENT	SD	D	A	SA
1	Teaching primary maths using activity-based strategy will bring about meaningful learning.				
2	The foundation for in-depth understanding of maths at secondary and higher institutions could only be built with activity-based lessons at primary school.				
3	I prefer activity-based maths lesson to teacher-centred lesson				
4	I understand many maths concept better with activities than when I was taught through teacher-centred				
5	I will like to know more on how to use activity-based lesson on other topics in maths				
6	Activity-based lesson do waste time.				
7	I cannot relate the activities to mathematics concepts that I am learning.				
8	Time available for mathematics lesson on the time-table is too short for activities, so, I will not use it.				
9	All the needed materials for activities are not readily available, therefore the strategy cannot work.				
10	To improvise materials might be costly at times and also time consuming.				
11	There is the need to carry out training for in-service primary maths teachers on activity-based strategy because it is the solution to mass failure in maths.				
12	Most of the activities require more time, therefore, there must be a system of using it in the primary schools now.				
13	I will use activity-based lesson, only if manipulative materials are supplied by the school.				
14	I will improvise materials to teach pupils maths in activity-based lesson so that they could understand better.				

15	I can use my personal money to buy manipulative materials to teach pupils primary maths.				
16	I will rather demonstrate with materials and allow the students to observe than using chalk and talk method				
17	Teacher centred activity-based teaching is better than the direct instruction method commonly used by primary mathematics teachers				
18	If I do not have enough materials to go round the pupils, I will use direct instruction to teach primary maths and not demonstration with materials				
19	Pupils activity-based and teacher demonstration is better than direct instruction strategy for primary maths				
20	I prefer direct instruction to both pupils activity-based and teacher demonstration strategy to teach primary maths.				