DEVELOPMENT AND UTILISATION OF AN INSTRUCTIONAL PROGRAMME FOR IMPACTING COMPETENCE IN LANGUAGE OF GRAPHICS ORIENTATION (LOGO) AT PRIMARY SCHOOL LEVEL IN IBADAN, NIGERIA

BY

Adetunmbi Laolu AKINYEMI
N.C.E (Business Computer Education) The Polytechnic Ibadan, Ibadan,
B.Ed (Early Childhood Education) University of Ibadan, Ibadan,
M.Ed (Educational Technology) University of Ibadan

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ABSTRACT

Computers enhance the process of understanding when used for teaching and learning. This made the Nigerian Government to introduce computer studies into the basic education curriculum. However, the content and activities in the computer basic curriculum are centred mostly around browsing and clicking and not on programming as many believed that programming is for adults. This study, therefore, developed a Language of Graphics Orientation (LOGO) instructional package and investigated its impact on primary school pupils' competence in LOGO. It also examined the influence of age, gender, computer literacy and school type on competence in the programme.

The study adopted one group pretest-posttest quasi-experimental design. A 20-module instructional package was developed based on Kerr's model of curriculum development. Three hundred and forty-nine pupils aged 5, 6, 7 and 8years and eight computer studies teachers purposively drawn from two private and two public primary schools participated in the study. Five instruments were used: Achievement Test in LOGO (r =0.70), Teachers' Perception Scale on LOGO, (r = 0.89), Challenges of Package Usage Scale (r =0.72), Utilization Scale for Package (r = 0.75) and Computer Literacy Scale (r = 0.75). Five research questions were answered and five hypotheses tested at 0.05 level of significance. Data were analysed using descriptive statistics, t-test and analysis of variance.

The LOGO instructional package was validated in a pilot study; results showed that the package had a good face and content validity which was measured in terms of coverage, sequence and appropriateness for the pupils as perceived by their teachers. Teachers' perception during the process of development in terms of conceptualisation was 0.8, identification of basic objectives 0.7, designing of package 0.7, try-out 0.7, revision 0.7 and teacher training 0.7. The instructional package was appropriate for pupils' age 1.0, presentation of illustrations 0.9 and content sequence 1.0. The difference in the pupils' pretest ($\bar{x}$ = 4.10) and posttest ($\bar{x}$ = 27.88) competence mean scores in LOGO was significant ($t = 53.56$; df = 348; $p < 0.05$). There was significant effect of age on pupils competence in LOGO ($F_{(3,345)} = 45.94$; $p < 0.05$). Pupils aged 8years had highest mean competence score ($\bar{x}$ = 34.20) followed by those of age 7 ($\bar{x}$=29.71), 6 ($\bar{x}$ = 26.96) and 5 ($\bar{x}$ = 20.53). There was no significant effect of gender on pupils' competence. Furthermore, there was significant effect of computer literacy on pupils' competence (t=8.26; df= 347; $p<0.05$) in favour of pupils with high level of computer literacy ($\bar{x}$= 31.54). There was significant effect of school type on pupils' competence (t = 8.13; df = 347; $p < 0.05$) with private school pupils obtaining higher mean score ($\bar{x}$ = 31.56) than public school pupils ($\bar{x}$ = 24.38).

The developed Language of Graphics Orientation instructional package enhanced the competence of primary school pupils in computer programming irrespective of age, computer literacy level and school type. It is therefore recommended that LOGO should be included in computer studies curriculum for primary schools as from age six.

Key words: Computer literacy, Instructional Programme, Development and Utilization of LOGO

Word count: 490

CERTIFICATION

I certify that this work was carried out by Adetunmbi Laolu AKINYEMI in the Department of Teacher Education, University of Ibadan.

……………………………………………..
SUPERVISOR
Dr. Ayotola Aremu
B. Sc. Electrical & Electronics Engr. (Ife)
PGDE, M.Ed, Ph.D (Ibadan)
Associate Professor
Department of Teacher Education
University of Ibadan, Ibadan.

DEDICATION

This thesis is dedicated to God Almighty, the Beginning and the End, who, through His awe-inspiring grace and mercies saw me through the entire work – to Him is the GLORY, HONOUR AND PRAISE. **THANK YOU LORD.**

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CHAPTER ONE

INTRODUCTION

1.1 Background to the study

Primary Education, which prepares children in fundamental skills and knowledge areas, can be described as the early stages of formal or organized education where it is important to lay solid and strong foundation for children prior to secondary education. It is believe to be the most important level of education because it is the foundation to all other levels of education. Primary school is the place where the child acquires the fundamental knowledge, skills, thoughts, feelings and actions which are considered necessary for all citizens regardless of social status, vocation or gender (Orukotan and Oladipo, 1994). This level of education does not only serve as the bedrock of subsequent levels of education but it is also regarded as the gateway to all higher levels of education that produce scientists, teachers, doctors, engineers and other highly skilled professionals that every country requires (Bruns *et al*., 2003).

The National Policy on Education (FRN, 2004) defines primary education as the education given in an educational institution to children aged 6 to 11+ years. The policy highlights the necessary objectives in the education system, which includes:

(i) the laying of a sound basis for scientific and reflective thinking;

(ii) giving the child opportunities for developing manipulative skills that will enable him to function effectively in the society within the limits of his capacity;

(iii) providing basic tools for further educational advancement, including preparation for trades and crafts of the locality (Section 4, Subsection 18 p. 14).

In order to achieve the above, the document, in section 4, subsection 19d suggests practical, exploratory and experimental methods of teaching and learning for Nigerian primary schools. In view of this, the Federal Ministry of Education, with the intention of improving the quality of education and facilitating national development, set up a committee in 1988 to ensure the implementation of computer literacy at the national level. One of the recommendations of that committee was that computer literacy should be introduced to teachers and students at all levels of education system (Idowu *et al*., 2004).

In recent times, Information and Communication Technologies (ICTs) have revolutionized pedagogical methods and expanded access to quality education (World Bank, 2002). ICT is a set of technological tools and resources used to communicate, create, disseminate, store and manage information. ICT includes computers (desktop, laptop, and handheld computers); digital cameras; creativity and communication software and tools; the Internet; telephones, fax machines, mobile telephones, tape recorders, interactive stories, simulated environments and computer games, programmable toys and "control" technologies, video-conferencing technologies and closed-circuit television, data projectors, electronic whiteboards and more (Bolstad, 2004).

ICT has become a transformational tool and is having a revolutionary impact on how the world is perceived and how we live in it (Vincent 2001; Agbatogun, 2010). According to Abimbade *et al*. (2003), the impact of technology worldwide has led to the globalization of information, communication and technology. In some countries, ICT is at the centre of educational reform efforts that involve its use in coordination, with changes in curriculum, teacher training, pedagogy and assessment (Kozma, 2005). Countries like Singapore (Ministry of Education, Singapore, 2000), Norway (Ministry of Education, Research and Church Affairs, Norway, 2000) and Chile (Ministerio de Education, Republica de Chile, 1998) have taken the position that the integration of ICT into classrooms and curricula can improve educational systems and prepare students for the 21st century learning society. In current classroom applications, ICT serves the following purposes: it helps pupils to acquire confidence and pleasure in using new technologies, it makes pupils become familiar with some everyday ICT applications, and to be able to evaluate the technology's potential and limitations; it also assist in enriching and extending learning throughout the curriculum by supporting collaborative learning and independent study, moreover, it enables pupils to work at a more demanding level by averting boring, time-consuming, routine tasks (Drossos and Kiridis, 2000).

Computers, which are integral part of ICT, motivate young children and contribute to their cognitive and social development (NAEYC, 1996). Some experts in the field of education agree that when properly used, computers hold great promise to improve teaching and learning, in addition to shaping workforce opportunities (Aduwa-Ogbiegbaen and Iyamu, 2005). Despite widespread claims about computer potential to benefit education (Harrison *et al*., 2002; Cox., 2003; Somekh *et al*., 2006), it has made comparatively little impact on teaching and learning in schools (Reynolds., 2003; Jamieson., 2006). Research on young children and technology has moved beyond simple questions to considering the implications of these changing perspectives on the use of technology in early childhood education. What teachers need to understand is how best to aid learning, what types of learning they should facilitate, what type of tools are appropriate or beneficial to allow children reap the greatest benefits from using computer and how they could serve the needs of diverse populations. To tackle these, there is the need to acquaint the children with learning tools such as computer software. This would assist them in designing packages for solving problems they might face in future. The software must be developmentally appropriate, that is, consistent with the way children learn and develop. It must also be found useful as a support to the curriculum designed for the pupils (NAEYC, 1996). Globally, the trend of the evolving nature of knowledge in most careers, disciplines and curricular content absolutely require students' development of necessary competence in computer skills and proficiency in computer usage because it is viewed as vital skill for student's success in their academic pursuit and professional lives (Duvel and Pate, 2004; Tillman, 2003; Yusuf, 2005).

The use of computer is so prevalent in contemporary world that any educational programme or course of study in the country's educational institutions must embrace computers to remain viable (Duruamaku-Dim, 2005). In Nigeria, the Federal Government, recognising the importance of computer education, has made a policy statement to incorporate computer studies into basic education. The objectives of the computer component of the basic education curriculum are to assist the learners to: acquire basic computer skills such as the use of the keyboard, mouse and operating systems; use the computer to facilitate learning electronically and to develop a reasonable level of competence in ICT applications that will engender entrepreneurial skills (NERDC, 2007).

According to NERDC (2007), the curriculum is learner-centred, thematic and activity- based. Emphasis is on the development of learners' usage and appreciation of the applications of the computer and emerging technology in everyday life. For these reasons, it is expected that pupils should be able to identify the various parts of the computer, use and apply software (word processing), communicate (send and receive messages) and other activities, such as playing games and music and watching educational films. It is also expected that pupils should be able to set up and boot a computer system. From the foregoing, it is clear that the curriculum was designed with good intention. It was designed to make pupils aware of the capability of computers and give them the skills to manipulate them. However, while specific technical skills are certainly important for pupils to learn, they do not provide adequate foundation for them to transfer and apply the skills at different situations. Pupils may learn isolated skills and tools, but they may still lack an understanding of how those various skills fit together to solve problems and complete tasks. Pupils need to be able to use computers flexibly, creatively and purposefully.

The curriculum prepared by the government for computer studies for basic education in Nigeria shows that programming language is not included in the curriculum. The present trends focus on introducing pupils to a wide range of different applications, such as word processing, spreadsheets, graphics software, and communication packages. While these are important skills, teaching their use often places children in the role of consumers of software programmed by others for them. The main problem is that the creative potential of pupils will not be well-developed compared to their counterparts in the developed nations who have the opportunity of being exposed to fully incorporated programming language curriculum in the latter even young children are introduced to some of the powerful principles involved in learning programming. This may imply that the Nigerian pupils may lack creative development through computer studies. However, the content and activities in the Computer Basic Curriculum is centered mostly around browsing and clicking and not on programming, as many believe that programming is for adults. The latter also may be the reason why there is a dearth of empirical studies on programming among primary school pupils. While it is noticeable that computers have been instrumental in radical educational reform in some countries (Kozma, 2005), they seem to have had little or no effect on teaching and learning strategies in both public and private primary schools in Ibadan. Despite the fact that the Federal Government has made a policy statement to incorporate Computer Studies into basic education, the policy is not yet operational in many public and private primary schools in Ibadan as revealed during a personal visit to some public and private primary schools in Ibadan, Oyo State. This was due to the fact that the computer curriculum had not been circulated to many schools as at 2012/2013 academic session. However, some public and private primary schools in Ibadan have started Computer Studies.

The emerging educational institutions as well as the policy statement on computer teaching and learning in Nigeria obviously shows that programming language, which provides an understanding of the functioning of the computer, computer software and enhances the creative potential of pupils, is not included in Computer Studies curriculum. Thus, the creative potentials of pupils will not be well-exploited in the learning of computer in schools. However, most studies on computer usage among school pupils concentrated on browsing and clicking as contained in the curriculum without focusing on such aspects as programming; pupils are still not playing active roles, which is integral parts of constructive learning (Ormond, 2003).

It is, therefore, necessary to include software that engage learners in activities in Nigerian Primary School Curriculum. There are different types of computer programming for children, such as Alice: developed to encourage girls to write programming; kudo: RoboMind; Sratch: Language of Graphics Orientation (LOGO). One of the globally accepted programming languages to introduce programming in Nigerian curriculum is the Language of Graphic Orientation (LOGO). LOGO is a child-friendly computer language that was developed by Seymour Papert at the Massachusetts Institute of Technology (USA) in 1968 and was intended to allow small children to use the computer as a learning tool (Papert, 1980; Steketee, 2005). The computer programming language LOGO was developed specially for children (Papert, 1980). Its main difference from other programming languages is that the tool used in LOGO programming is an image of a turtle on the screen, LOGO is based on Papert's (1980) learning theory. According to him, learning is most effective in an open, unstructured environment. With discovery learning, children learn problem-solving skills in an open LOGO-learning environment. The most enthusiastic advocate of LOGO, Papert (1980), puts forward three arguments for using LOGO with children.

First, he argued that Turtle Graphic provide an ideal bridge between the abstract world of mathematics and the concrete world of reality. By writing instructions to control the Turtle, children are required to use complex mathematics in a context where they can see the immediate point of what they are doing. They are, thus, less likely to develop the fear and suspicion of mathematics that characterizes many adult today. Secondly, he claimed that LOGO teaches an approach to planning and problem-solving that may be generalised to other areas of learning. In order to produce a drawing or pattern, children must first plan what they want to do, breaking the problem down into more familiar elements. They must then put their program into operation, noting whether the Turtle does what they wanted it to do. If it does not, they must then start a process of debugging, or checking the program against the original plan. This process not only teaches children a healthy approach to solving problems, but also makes them see mistakes or errors as further problems to be overcome. Thirdly, his argument was that LOGO embodies an approach to the computers which is very different from most other forms of computer-aided learning. He contrasts LOGO with 'drill-and-practice' programs in which the child mechanically works through problems set by the computer, and argued strongly for the open-ended discovery-learning which LOGO encourages. "Let the child control the computer, not the computer controlling the child" is Papert's message. This is an encouraging message for those concerned that computers will have a rigidifying effect on children's thinking.

Of all the application of the computer to education, none has generated as much excitement as computer programming, especially LOGO which is a language for learning that encourages students to explore, to learn and to think. Most children who use computers are not programmers. Yet many would like to create their own software, and to customize the software that they have. Typically, they would like to create programs that are similar to the ones that they use, such as games and educational simulations, which are highly interactive and graphically rich. But there are no suitable tools for this kind of programming task that are easy enough for beginners to pick up and use. The powerful programming environments used by commercial software developers are clearly inappropriate for beginners because they are very complex and assume that the user has extensive programming expertise. Other tools designed for beginners are effective only in limited domains, such as Visual Basic for creating applications that are based on forms and dialog boxes, or spreadsheets for tabular numeric applications.

LOGO is designed to have a "low threshold and no ceiling": It is accessible to everyone, including young children, and also supports complex explorations and sophisticated projects by experienced users. LOGO seems to be the right tool to teach the process of learning and thinking. Papert combined his scientific skills with Piaget's theories on how children think and learn to create a software program that enables children to use programming language (Torgerson, 1984). Maddux and Rhoda (1984) aver that LOGO is different from other programming languages because it can be used with very little knowledge of computer language. LOGO comes in many different forms, of which the most widely known is Turtle Graphics. With Turtle Graphics, the child uses LOGO to control the movements of a device known as the Turtle. The turtle can be either a small-wheeled robot which crawls around on the floor, or a simulated Turtle on a computer screen. Both types of Turtle have pens which can leave a trail behind them. The child can thus instruct the Turtle to move around its environment in a particular way, and in so doing will produce a drawing or pattern. Only a five or ten-minute presentation is required to introduce the four basic commands for turtle movement. The commands are used to create and manipulate graphics, geometrical shapes, and designs; the purpose of LOGO is not, of course, merely to provide children with a high technology device for drawing and making designs. Rather, its value lies in the ways it requires them to think if they are to achieve their objectives (Papert, 1980).

The turtle's distance and angle are determined by the numerical inputs placed after the directions commands. In the immediate mode, children learn to create designs, drawing, and geometrical figures instantly. The child types the command and presses the enter key which moves the turtle. Once the student has mastered the immediate mode, he/she can advance to the next level, which is the program mode. In the program mode, the commands are no longer carried out individually. A series of commands are written, then, the enter key is pressed and the command program is executed on the monitor. LOGO provides immediate feedback, which allows students to correct and learn from their errors, and to exercise their self-correcting and problem- solving skill. LOGO provides students with a variety of learning strategies. Students with short attention spans can benefit from LOGO because they can work at their own pace. According to Emihovich and Miller (1988), LOGO can also help children acquire meta-cognitive skills, that is, children reflect upon their thinking; improved problem-solving ability and mathematics ideas; enhanced spatial orientation and ability, especially regarding shape and angle awareness; and fluency with the technology such that they learn to master the technological environment and become not just consumers but creators of new technologies (Clements and Nastasi, 1999; Resnick, 2001; Clements and Samara, 2002). Planning the turtle's movements provides students with experience in how they think and learn. This higher-level thought process applied to a concrete object teaches them content, thinking styles, and behaviours needed for academic success. There is substantial evidence that young children can learn LOGO and can transfer their knowledge to other areas, such as reading, communication, mathematics, map-reading tasks and interpreting right and left rotation of objects (Vaidya, and McKeeby, 1985; Clements 2002). Furthermore, the knowledge and concepts the children encounter during their interactions with the computer are transferable to their everyday experiences (Vaidya and McKeeby, 1984). In a rapidly changing world, LOGO has the potential to accelerate, enrich, and deepen skills, to motivate and engage students, to help relate school experience to work practices, create economic viability for tomorrow's workers, as well as strengthen teaching and help schools change.

The integration of Computer Studies into the educational sector has created a lot of social stereotypic factors among scholars of ICTs, one of which is gender. Computer-related activities have been viewed as a male-dominated work for some time now (Markauskaite, 2006). Studies have shown that boys are more aggressive users of computers than girls (Sanders, 1984); software is developed with male students in mind (Schubert, 2005) and girls tend to identify computing as a male activity (Bayhan and Sipal, 2008). Many scholars also found that girls have a less positive computer attitude than boys (Makrakis and Sawada, 1996; Volman, 1997; Huber and Schofield, 1998). However, differences are not so great in younger pupils (Durndell *et al.*, 1995; Combe *et al.*, 1997). There are also indications that girls achieve less than boys in computer tasks (Barbieri and Light, 1992). Differences in attitude between boys and girls are most common in the aspects of "confidence in working with computer" and "plans to work with computer in the future" (Volman, 2005). Studies on gender differences can be misleading without reference to age (Morri *et al.*, 2005). Studies have revealed that 5-year-old pupils who have been exposed to the computer under various circumstances score higher on logical thinking tasks than children who have not been exposed to LOGO (Delgelman, 1986; Emihovich and Miller, 1988). According to Gillespie and Beisser (2001), LOGO Programming Language can be developmentally appropriate for children in Piaget's pre-operational stage, that is, 2 to 7 year-old children because, at this stage, children begin to represent the world with words, images and drawings. It is important to find out the age level at which to introduce Programming Language to Nigerian pupils in order to help them acquire new knowledge. The increasing interest and performance of pupils in many ICT-related studies have been attributed to the type of schools (private or public) such pupils attend.

This has been a subject of debate among educators (Corten and Dronkers, 2006). Generally, it has been observed that pupils in private schools perform better than their counterparts in public schools. Etsey *et al*., (2005), in a study of 60 schools from peri-urban (29 schools) and rural (31 schools) areas in Ghana, found that academic performance was better in private schools than public schools because of more effective supervision of work. Factors such as school type have also been speculated to influence technology use. Studies have shown that variations in ratings existed as a result of the types of school (Fuchs and Wossmann, 2004; Altonji, 2005).

While it is true that all the factors discussed above may or may not influence the use of computer among pupils, it may also be noteworthy to understand that one of the recurring themes in the under-utilization of ICT-related tasks is lack of relevant competencies. Computer literacy is .defined as the ability to make use of computer system for word processing, analyse data, develop small computer programmes, browse the Internet and install software (Idowu *et al*., 2004; Hall, 2005). The primary goal of any use of computers with young children might be considered computer literacy (that is teaching children what computers can do and how to use them). Computer literacy can include teaching children how to use the computer as a tool (a medium with which to calculate, draw or write), as a tutor (to provide instruction), as a tutee (to be programmed), or as a combination of these three (Tella and Mutula, 2008). Therefore, this study investigated whether level of computer literacy affects the competency in LOGO Programming Language. The aim of this work is to give a direction on how to integrate programming language into the Computer studies curriculum in Nigerian primary schools using LOGO. In this study, pupils' age, gender, Computer literacy and school type were considered as factors that could predict pupil's achievement in LOGO programming language

1.2 **Statement of the problem**

The introduction of Computer Studies into teaching and learning is a giant stride towards improving the quality of education. As an integral part of the educational system, Computer Studies strengthen the relevance of education to the increasingly digital workplace and raises educational quality at all level. It also offers unique opportunities for learning through exploration, creative problem-solving and self-guided instruction.

It is against this backdrop that this study developed a LOGO Programming Instructional Package for primary school pupils in Ibadan, Oyo State, Nigeria, utilized the same in the teaching-learning process and found the extent to which pupils would be able to accomplish different tasks in LOGO. It also examined the influence of age, gender, computer literacy and school type on pupils' competence in LOGO Programming Language.

1.3 Research Questions

This study provided answers to the following questions:

1. What is the perception of teachers on the use of LOGO Instructional Package (LIP) in Nursery and Primary schools?
2. What challenges will Nigerian teachers face in using LOGO Programming Language in the classroom?
3. How appropriate is the Instructional Package for teaching and learning LOGO in terms of
   - i. Age relevance
   - ii. Presentation of illustrations
   - iii. Sequence of content
4. At what age do public primary school pupils acquire competence in each of the 20 LOGO Programming Language Package Modules?
5. At what age do private primary school pupils acquire competence in each of the 20 LOGO Programming Language Package Modules?

1.4 Hypotheses

The following hypotheses were tested at 0.05 level of significance:

H_{o1}: There is no significant difference in the pretest and posttest achievement scores of primary school pupils in LOGO Programming Language.

H_{o2}: There is no significant effect of age on pupils' competence in LOGO Programming Language.

H_{o3}: There is no significant mean difference of male and female pupils' achievement in LOGO Programming Language.

$H_{o4:}$ There is no significant mean difference in achievement of pupil's with levels of computer literacy.

$H_{o5:}$ There is no significant mean difference of pupils' in public and private schools in achievement in LOGO Programming Language.

1.5 Scope of the study

This study covered four groups of pupils from Piaget's four stages of cognitive development, that is, two later stages in pre-operational stage (2 to 6 years) and two early stages of concrete operational stage (7–11 years), to be able to find out the right age and to what extent the pupils will be able to accomplish different levels of objectives in LOGO. This study covered four schools, two public and two private nursery and primary schools in Ibadan North Local Government Area of Oyo State, Nigeria.

1.6 Significance of the study

The package developed from this research would be a tool for teaching and learning programming language at primary school level. It would enable pupils to develop and enhance their creative abilities in LOGO Programming Language upon which higher order thinking skills and creativity can be built upon. In addition, it is also a commercially viable product since there is dearth of information in terms of introducing programming language at the primary level in Nigeria.

The findings provides information on variables such as gender, age, computer literacy and school type as they affect pupils' development of the programming skills and how such factors can assist computer software designers in designing and producing software is developmental appropriate. This package will serve as basis for introducing programming in primary schools. Besides, different stakeholders will be motivated to invest in the production of LOGO package. Finally, the finding will provide empirical basis for research in programming language among primary school pupils in Nigeria and serve as a basis for expanding the existing computer curriculum.

1.7 Operational definitions of terms

Competence in LOGO: This refers to knowledge of LOGO Programming Language and skill in LOGO for making different designs and complete LOGO activities. Pupils that complete their task at an average level are said to be competent.

Graphics: These are drawings or other non-text designs created on the computer.

Instructional Programme: It is a teaching tool which contains the contents, instructional materials and activities the teacher will follow for LOGO software.

LOGO: This is the acronym for Language of Graphics Orientation, a computer programming language which enables young children to explore concepts and develop ideas through graphics.

Programming: This refers to the process of instructing computer to perform a certain task through the LOGO software.

Turtle: This is a cursor which looks like a triangle. It is controlled using simple commands to draw objects on the screen.

Package: It consist of the instructions which the pupils will follow to make different designs after which there is an activity for the pupils to do.

CHAPTER TWO

REVIEW OF RELATED LITERATURE

The relevant studies are reviewed under the following headings: theoretical framework; ICT in education; ICT competences; Gender and ICT; Adoption and integration of information and communication technology into teaching and learning; Teacher perceptions of ICT in teaching and learning; the computer and young children; Problems and prospects of ICT in education; Historical background of LOGO Programming Language; Age and competence skills in LOGO; Gender and competence skills in LOGO; School type competence skills in LOGO and Computer literacy and competence skills in LOGO; Appraisal of literature reviewed.

2.1 Theoretical framework

This study is based on behaviourist learning theory and Piaget learning theory. Each of these theories is discussed below.

2.1.1 Behaviourist learning theories

The emphasis of Behaviourism is the observable indicators that show that learning is taking place. Gruender (1996) notes that behaviourism proposes that learning from technologies means using computers for drill and practice, because learning, according to this view, is a matter of imitation and practice. The behaviourists strongly advocate the role of adults in learning as they provide a model by which children learn through imitation. The adults also encourage children to continue using computer technology by providing them with positive reinforcement. However, behaviourism is often associated with pedagogic approaches that promote active learning by doing. It is based on observable changes in behaviour and focuses on a new behavioural pattern being repeated until it becomes automatic (Black, 1995).

They carried out different experiments to bring out the relevance of behaviourism in explaining human actions. Skinner (1958) in his study observes that particular reinforcement/punishment patterns were more successful. The principle of intermittent reinforcement states “that always reinforced behaviour increases rapidly in frequency, but also will extinguish rapidly when rewards cease”. Conversely, behaviour that is rewarded intermittently increases in frequency more slowly, but is more long lasting or resistant to extinction (Alessi, 2001). In assuming that human behaviour is learned, behaviourists also posit that all behaviours can also be unlearned, and replaced by new behaviours; that is, when a behaviour becomes unacceptable, it can be replaced by an acceptable one. A key element to this theory of learning is the reward response. The desired response must be rewarded in order for learning to take place (Parkay and Hass, 2000).

John Watson (1878-1958) and Skinner (1904-1990) are the two principal originators of behaviourist approaches to learning. Watson claimed that human behaviour result from specific stimuli that elicit certain responses. Watson's basic premise is that conclusions about human development should be based on observation of overt behaviour rather than speculation about subconscious motives or latent cognitive processes (Shaffer, 2000). Watson's view of learning is based, in part, on the studies of Ivan Pavlov (1849-1936). Pavlov was studying the digestive process and the interaction of salivation and stomach function when he realized that reflexes in the autonomic nervous system closely linked these phenomena. To determine whether external stimuli had an effect on this process, Pavlov rang a bell when he gave food to the experimental dogs. He noticed that the dogs salivated shortly before they were given food. He discovered that when the bell was rung at repeated feedings, the sound of the bell alone (a conditioned stimulus) would cause the dogs to salivate (a conditioned response). Pavlov also found that the conditioned reflex was repressed if the stimulus proved "wrong" too frequently; if the bell rang and no food appeared, the dog eventually ceased to salivate at the sound of the bell.

Expanding on Watson's basic stimulus-response model, Skinner developed a more comprehensive view of conditioning, known as operant conditioning. His model is based on the premise that satisfying responses are conditioned, while unsatisfying ones are not. Operant conditioning is the rewarding of part of a desired behaviour or a random act that approaches it. Skinner avers that "the things we call pleasant have an energizing or strengthening effect on our behavior" (Skinner, 1972). Through his research on animals, he concluded that both animals and humans would repeat acts that led to favourable outcomes, and suppress those that produce unfavourable results (Shaffer, 2000). If a rat presses a bar and receives a food pellet, it is likely to press it again. Skinner defines the bar-pressing response as operant, and the food pellet as a reinforcer. Punishers, on the other hand, are consequences that suppress a response and decrease the likelihood that it will occur in the future. If the rat had been shocked every time it pressed the bar that behaviour would cease. Skinner claims that the habits that each of us develops result from our unique operant learning experiences (Shaffer, 2000).

Behaviourist pedagogy aims to promote and modify observable behaviour. It considers learning to be a behaviour that shows acquisition of knowledge or skills. According to Standridge (2002), among the methods derived from behaviourist theory for practical classroom application are the "classic" Skinnerian behaviourist rules:

- Positive reinforcement (reward): A stimulus presented that will increase behaviour, for example giving praise to a student
- Negative reinforcement (withdrawal of negative effects): A response that removes something that students find displeasing such as students who regularly turn in homework can skip a graded quiz.
- Positive Punishment: for instance, asking a student to stay after class
- Negative Punishment: such as remove access to computer after misbehaving
- Extinction (non-enforcement): In particular, behaviour that was always reinforced through positive stimili will decrease when it is no longer enforced.

In addition Standridge (2002) adds these: modelling is observational learning by which children learn favourable and unfavorable responses by observing those around them, cueing: Providing a child with a verbal or non-verbal (beforehand) cue as to the appropriateness of a behavior, contracts: teacher and student agree on (new) behaviour patterns, consequences: are enacted immediately after a behavior has occurred and re-conditioning by extinction: Remove a previously introduced stimulus that did not prove to be successful. For example, instead of taking off 1/2 for late homework, don't grade it at all.

Built on top of this reinforcement, punishment and extinction bricks, there are more complex strategies like shaping: the process of gradually changing the quality of a response and behavior modification. Behaviorist theory especially in the classroom can be rewarding for both students and teachers. Behavioural change occurs for a reason; students work for things that bring them positive feelings, and for approval from people they admire. They change behaviours to satisfy the desires they have learned to value. In this study, children of diverse ages that were not acquainted with computer programming were exposed to 20 modules on LOGO Instructional Package. This theory shows that learning occurs when a correct response is demonstrated following the presentation of a specific environmental stimulus. The stimulus is the teaching of pupils on how to write computer programs using LOGO instructional package; this stimulus is broken down into definite instructional steps, as each step is performed, the pupils can view graphically the result. Their response, if correct is reinforced by a graphical part which can see. This positive reinforcement encourages them on to the next instructional steps. On the contrariwise, if their response to the stimulus (instructional step) is not correct, the part of the graphic they are trying to construct will not show up. Also, error messages would be displayed. This immediate knowledge of results acting as a reinforcer enables the pupils to adjust their response. These processes go on and on till they arrive at the final graphic. This offer a great deal of user control.

2.1.2 **Piaget's learning theory**

Behaviourism as a learning theory is most closely associated with Jean Piaget, the Swiss psychologist, who spent decades studying and documenting the learning processes of young children. Piaget's theory provides a solid framework for understanding children's ways of doing and thinking at different levels of their development. It gives a precious window into what children are generally interested in and capable of at different ages. His idea about human learning is that people are active processors of information. Instead of being passive respondents to environmental conditions, human beings are actively involved in interpreting and learning from the events around them.

Jean Piaget theorized that children are innately gifted, active learners, familiarizing themselves with the world long before they ever realize it (Papert, 1980). Children construct knowledge independently through their experiences with the world (Schetz and Stremmel, 1994). Given this framework, teaching methods with a Piagetian perspective have resulted in the belief that children need direct experiences and active involvement in their world through exploration and play (Schetz and Stremmel, 1994). Piagetian perspective has extended to the use of computers with young children through one of Piaget's students, Seymour Papert. In his 1980 book, *Mindstorms*, Papert argues that computers are a good tool for promoting this kind of active discovery because computers allow children to be in control of their own learning. Despite not being able to physically manipulate a computer, computers do still provide direct, meaningful learning experiences that are consistent with Piagetian theory (Clements *et al*., 1993).

According to Piaget, people interact with their environment through unchanging processes known as assimilation and accommodation. Piaget's main interest was in the development of thinking. He believed that cognitive development occurs in distinct stages, with thought processes at each stage building on previous ones. The ability of a child to use symbols and think in an abstract manner increases with each subsequent stage until he is able to manipulate abstract concepts. These four stages are: Sensory motor stage (birth to 2 years); preoperational stage (ages 2 to 6); concrete operational (ages 7 to 11) and formal operational (ages11 to 15).

Bobby (2008) avers that a major contribution of Piagetian theory concerns the developmental stages of children's cognition. His work on children's quantitative development has provided mathematics educators with crucial insights into how children learn mathematical concepts and ideas. A developmental stage consists of a period of months or years when certain development takes place. Although students are usually grouped by chronological age, their developmental levels (Weinert and Helmke, 1998), as well as the rate at which individual children pass through each stage may differ significantly. This difference may depend on maturity, experience, culture, and the ability of the child (Papila and Olds, 1996). Berk (1997) asserts that Piaget believed that children develop steadily and gradually throughout the varying stages and that the experiences in one stage form the foundations for movement to the next stage. All people pass through each stage before starting the next one; no one skips any stage. This implies that older children, and even adults, who have not passed through later stages process information in ways that are characteristics of young children at the same developmental stage (Eggen and Kauchak, 2000). Cognitive development results from the interactions that children have with their physical and social environments. The four stages identified earlier are now examined more closely.

Sensori-motor stage

An infant's mental and cognitive attributes develop from birth until the appearance of language. This stage is characterized by the progressive acquisition of object permanence, in which the child becomes able to find objects after they have been displaced, even if the objects have been taken out of his field of vision. For example, Piaget's experiments at this stage include hiding an object under a pillow to see if the baby finds the object. An additional characteristic of children at this stage is their ability to link numbers to objects (Piaget, 1977) (for example, one dog, two cats, three pigs, four hippos). To develop the mathematical capability of a child in this stage, the child's ability might be enhanced if he is allowed ample opportunity to act on the environment in unrestricted (but safe) ways in order to start building concepts (Martin, 2000). Evidence suggests that children at the sensorimotor stage have some understanding of the concepts of numbers and counting (Fuson, 1988). The education of children at this stage of development should lay a solid mathematical foundation by providing activities that incorporate counting and thus enhance children's conceptual development of number. For example, teachers and parents can help children count their fingers, toys, and candies. Questions such as "Who has more?" or "Are there enough?" could be a part of the daily lives of children as young as two or three years of age. Another activity that could enhance the mathematical development of children at this stage connects mathematics and literature. There is a plethora of children's books that embed mathematical content. The child also begins to understand that his or her actions could cause another action, for example, kicking a mobile to make the mobile move. This is an example of goal-directed behavior. Children in the sensorimotor stage can reverse actions, but cannot yet reverse thinking (Woolfolk, 2004). At this age level, the advanced color graphics and sound capabilities of today's microcomputers seem like the ideal tools for creating a most elaborate "busy-box' for the very young child. Since fascination with colors, changes in shape, sound and patterns are essential elements in the experimental world of children at this stage of development, sensory stimulation by computer may serve the same functions that brightly colored toys and objects hanging over the cribs of infants today serve.

Pre-operational stage

The characteristics of this stage include an increase in language ability (with over-generalizations), symbolic thought, egocentric perspective, and limited logic. In this second stage, children should engage in problem-solving tasks that incorporate available materials such as blocks, sand, and water. While the child is working with a problem, the teacher should elicit conversation from the child. The verbalization of the child, as well as his actions on the materials, gives a basis that permits the teacher to infer the mechanisms of the child's thought processes. There is lack of logic at this stage of development; rational thought makes little appearance. The child links together unrelated events, sees objects as possessing life, does not understand point-of-view, and cannot reverse operations. For example, a child at this stage who understands that adding four to five yields nine cannot yet perform the reverse operation of taking four from nine. Children's perceptions at this stage of development are generally restricted to one aspect or dimension of an object at the expense of the other aspects. For example, Piaget tested the concept of conservation by pouring the same amount of liquid into two similar containers. When the liquid from one container was poured into a third, wider container, the level was lower and the child thought there was less liquid in the third container. Thus the child was using one dimension, height, as the basis for his judgment of another dimension, volume.

Teaching students in this stage of development should employ effective questioning about characterizing objects. For example, when students investigate geometric shapes, a teacher could ask students to group the shapes according to similar characteristics. Questions following the investigation could include, "How did you decide where each object belonged? Are there other ways to group these together?" Engaging in discussion or interactions with the children may engender the children's discovery of the variety of ways to group objects, thus helping them to think about the quantities in novel ways (Thompson, 1990). Although, the abilities of children at this age are limited to the physical, children at this level can begin to learn much from computers, like ages six or seven can easily learn to boot a computer, work a joystick controller, and use a keyboard. At this stage of cognitive development, the computer can become a useful training tool to teach number and letter recognition, color discrimination, sight vocabulary, and some number skills. Since this period covers a wide span of ages, it would not be realistic to think that a two-year-old could accomplish the same tasks as a seven-year-old. These children can have lots of fun drawing swirls and scribbles with the joystick using a relatively simple Basic program. Although this may be more fun than educational, it does stimulate various eye movements, gets children to use their eyes and hands together, and provides an opportunity for attaining mastery over an environment. Children at the upper range of this developmental period (5 to 7years) can start to learn spelling exercises like Hangman, and game-oriented drill-practice exercises in CAI. Exercises such as these have often been called fancy flash cards, but this should not be looked at negatively. Both flash cards and the computer provide training for a task that may be boring but necessary (memorization). Some things are best learned by memorization and flash cards as well as computer assisted drills. Both provide the practice necessary to learn something by rote.

Concrete operations stage:

The third stage is characterized by remarkable cognitive growth, when children's development of language and acquisition of basic skills accelerate dramatically. Children at this stage utilize their senses in order to know; they can now consider two or three dimensions simultaneously instead of successively. For example, in the liquids experiment, if the child notices the lowered level of the liquid, he also notices the dish is wider, seeing both dimensions at the same time.

Additionally, seriation and classification are the two logical operations that develop during this stage (Piaget, 1977) and both are essential for understanding number concepts. Seriation is the ability to order objects according to increasing or decreasing length, weight, or volume. On the other hand, classification involves grouping objects on the basis of a common characteristic.

Burns and Silbey (2000) note that "hands-on experiences and multiple ways of representing a mathematical solution can be ways of fostering the development of this cognitive stage". The importance of hands-on activities cannot be ignored at this stage. These activities provide students an avenue to make abstract ideas concrete, allowing them to get their hands on mathematical ideas and concepts as useful tools for solving problems because concrete experiences are needed, teachers might use manipulative materials with their students to explore concepts such as place value and arithmetical operations. Existing manipulative materials include: pattern blocks, Cuisenaire rods, algebra tiles, algebra cubes, geoboards, tangrams, counters, dice, and spinners. However, teachers are not limited to commercial materials; they can also use convenient materials in activities such as paper folding and cutting. As students use the materials, they acquire experiences that help lay the foundation for more advanced mathematical thinking. Furthermore, students' use of materials helps to build their mathematical confidence by giving them a way to test and confirm their reasoning.

Students in the later elementary years, according to Piaget, learn best through hands-on discovery learning, while working with tangible objects. Reasoning processes also begin to take shape in this stage. Piaget stated that the three basic reasoning skills acquired during this stage were identity, compensation, and reversibility. By this time, the child learns that a "person or object remains the same over time" (identity) and one action can cause changes in another (compensation). This child has an understanding of the concept of seriation – ordering objects by certain physical aspects. The child is also able to classify items by focusing on a certain aspect and grouping them accordingly (Woolfolk, 2004). In the later years of this period, children can start to become familiar with some of the Basic language commands, like the PRINT, INPUT, and GOTO statements. At this level, children can learn how to solve simple arithmetic problems using the computer primarily as a calculating tool. CAI tutorials and practice drills are very easily understood and enjoyed and can be implemented without much help from the classroom teacher or parent since the children now possess adequate reading skills. Using the computer to construct a model or simulation from scratch, and programming with advanced concepts such as conditional and branching statements are still beyond the capabilities of most children at this stage because they lack the sophisticated abstract reasoning ability required.

Formal operations stage

At this stage intelligence is demonstrated through the logical use of symbols related to abstract concepts. At this point, the person is capable of hypothetical and deductive reasoning. During this time, people develop the ability to think about abstract concepts. Piaget argues that deductive logic becomes important during the formal operational stage (Anderson, 1990). This type of thinking involves hypothetical situations and is often required in science and mathematics. Abstract thought emerges during the formal operational stage. Children tend to think very concretely and specifically in earlier stages. They begin to consider possible outcomes and consequences of actions. Problem-solving is demonstrated when they use trial-and-error to solve problems. The ability to systematically solve a problem in a logical and methodical way emerges. During this period children begin to understand and use sarcasm, double-entendre, and metaphor. They can be taught to exploit the computer to its fullest capacity, and are ready for their first real experiences in higher language programming. Simulations can be developed and learning about computers can be facilitated through the understanding of computer architecture. At this level children can create their own computer assisted instruction tools and exercises as well as benefit from drills and tutorials. This is not to say that every 14-year-old can or will be a master programmer, it simply means that, developmentally, children who have achieved the milestones of formal operational thinking will be ready for the experience of learning about more advanced computer concepts and applications.

Based on Piaget's proposed stages and ability levels at each stage provide short instruction and concrete examples and offer time for practice informed the choice of activities at each age level in this study. Realizing the need for more concrete objects to play with, the LOGO "turtle" was developed, so that children could draw with the LOGO programming language (Papert, 1980). It is a hands-on activity to create authentic experiences in which children begin to feel a sense of mastery over their world and a sense of belonging and understanding of what is going on in their environment. This philosophy follows Piaget's ideal that children should actively participate in their world and various environments so as to ensure they are not "passive" learners but "little scientists" who are actively engaged.

The Piaget's theory of human cognitive development is relevant to this study, as it provides explanation for the development of children's mental structures which are capable of influencing learning and understanding. In general, the knowledge of Piaget's stages helped the researcher to understand the cognitive development of the child as the researcher planned stage-appropriate activities to keep pupils active. Also, it was based on Piaget's theory of cognitive development that the researcher selected the age levels used in this study. In addition, the stages of all exercises were drawn with the developmental levels of children in mind, as the tasks in the modules were arranged from simplest to most challenging.

2.2 ICT in education

Governments and education systems around the world recognise the need for students to be skilled, creative and confident users of a wide range of information and communication technologies (Brush *et al.*, 2001; Charalambous and Karagiorgi, 2002; McNair and Galanouli, 2002; Rees, 2002; Voogt *et al.*, 2000; Lim *et al.*, 2004). ICT is evolving into a literacy in its own right alongside reading, writing and arithmetic (KCTR-CH Group, 2000). Students must master this literacy if they are to succeed within, and contribute to, a 'technology- savvy ' future workforce (Wheelwright, 1999). Furthermore, given the potential that ICTs have to foster higher order learning outcomes (Steketee *et al.*, 2001; Jonassen, 2002), it becomes imperative that students are exposed to these new learning environments.

Faruque and Kasagga (2012) observed that ICT is a set of technological tools and resources used to communicate, create, disseminate, store and manage information. ICT is one of the various factors that are drastically influencing occupational success, especially in the educational sector. The use of ICT in school enhances teaching and learning beyond the walls of the classroom. This meets a wide range of school-related needs, such as repeat practice for students, access to materials that are not available in school, and so on (Picciano and Seaman, 2007). In fact, ICT literacy has been a subject of educational research ever since the integration of technology into the education system either as a tool for self-study or as a teaching device. ICT is fundamentally changing the way people live, learn, and work (Aladejana 2007). When effectively integrated into a high-quality learning environment, ICT can help deepen students' content knowledge, engage them in constructing their own knowledge, and support the development of complex thinking skills (Kulik, 2003; Webb and Cox, 2004; Kozma, 2005). The potential of ICT as an instructional tool that enhances student learning and educational outcomes has been established in the literature (Kirschner and Woperies, 2003; Gulek and Demirtas, 2005; Markauskaite, 2006; Kazu and Yavulzalp, 2008). Research has also shown that the effectiveness in the use of ICT to support learning is a function of the curriculum content and the instructional strategy such that when appropriate content is addressed using appropriate strategies students and teachers will benefit (Cradler and Bridgforth, 2002). With these in mind new technologies such as learning tools; teaching tools across the curriculum; tools for communication and search of information; and tools for the development of ICT literacy should be used in primary schools (IP.E.P.TH., 1997).

Computers began to be placed in schools in the early 1980s. With regard to the early introduction of microcomputers in education in the 1980s, there were high expectations that it would make education more effective and motivating (Bransford *et al*., 2000; Yelland, 2001). Modern Technology offers many means of improving teaching and learning in the classroom (Lefebvre *et al*., 2006). Dawes (2001) is of the view that new technologies have the potential to support education across the curriculum and provide opportunities for effective communication between teachers and students in ways that have not been possible before.

Tella *et al*. (2007) note that teaching and learning can successfully take place through the application of electronic communication facilities between teachers and students. This has generated, sometimes, hope and dismay, and at other times, excitement and fear. Hope that many more learners can be reached at a more convenient pace than had erstwhile been the case, dismay that the infrastructure necessary for deploying an effective ICT platform is lacking in low-income countries like Nigeria (Olakulehin, 2007).

The use of information and communication technologies in the education process has been divided into two broad categories: The first is ICTs for education, which connote the development of information and communications technology specifically for teaching/learning purposes. The second is ICTs in education, which involves the adoption of general components of information and communication technologies in the teaching-learning process (Olakulehin, 2007).

Several studies argue that the use of new technologies in the classroom is essential for providing opportunities for students to learn to operate in an information age (Pelgrum and Law; 2003; Bingimlas, 2009). It is evident, as Yelland (2001) claims, that traditional educational environments do not seem to be suitable for preparing learners to function or be productive in the workplaces of today's society. Organisations that do not incorporate the use of new technologies in schools cannot seriously claim to prepare their students for life in the 21st century. This is line with Grimus (2000), view that "by teaching ICT skills in primary schools the pupils are prepared to face future developments based on proper understanding". Hepp *et al*. (2004) claim that ICTs have been utilized in education ever since their inception, but they have not always been massively present. Although at that time computers have not been fully integrated in the learning of traditional subject matter, the commonly accepted rhetoric that education systems would need to prepare citizens for lifelong learning in an information society boosted interest in ICTs (Pelgrum and Law, 2003). Education is at the core of the knowledge economy and learning society and the role of ICTs in schools is shifting dramatically (Kozma and Anderson 2002). The promise of information and communications technologies to enhance the basic education is a tremendously challenging area of development work today, in both poor and wealthy nations (Plomp *et al*., 1996; Kozma and Anderson 2002). Hepp *et al*. (2004) distinguish three objectives for the use of ICT in education): the use of ICT as object of study, the use of ICT as aspect of a discipline or profession; and the use of ICT as medium for teaching and learning. The use of ICT in education as object refers to learning about ICT, which enables students to use ICT in their daily life. The use of ICT as aspect refers to the development of ICT skills for professional or vocational purposes. The use of ICT as medium focuses on the use of ICT for the enhancement of the teaching and learning process. It is a fact that teachers are at the centre of curriculum change and they control the teaching and learning process. Therefore, they must be able to prepare young people for the knowledge society in which the competency to use ICT to acquire and process information is very important (Plomp *et al*., 1996).

Generally, however, the educational relevance of computers and other components of information technology cannot be overemphasized. Reference can be made to the period when Skinner applied programmed instructions to teaching machines, through Brunner's experiment with computer instruction, and the current wave of information transmission and exchange via the worldwide web, we have seen different applications of ICTs in enhancing cognitive development. According to Thomas and Ranga in UNESCO (2004) the pedagogical applicability of the ICTs is concerned essentially with more effective learning and with the support of the various components of ICTs. Almost all subjects, ranging from mathematics (the most structured) to music (the least structured) can be learnt with the help of computers. Olakulehin (2007) notes that pedagogic application of ICTs involves effective learning with the aid of computers and other information technologies, serving the purpose of learning aids, which plays complementary roles in teaching/learning situations, rather than supplements to the teacher/instructor/facilitator.

The computer is regarded as an add-on rather than a replacing device. The pedagogic uses of the computer necessitate the development, among teachers as well as students, of skills and attitudes related to effective use of information and communication technologies. Besides literacy, ICTs also facilitate learning to programme, learning in subject areas and learning at home on one's own. These necessitate the use of new methods, like modelling, simulation, use of data bases, guided discovery, and closed-word exploration, to mention a few.

The implications in terms of changes in the teaching strategy, instructional content, role of the teachers and context of the curricula are obvious as well as inevitable. Pedagogy, through the application of information and communications technologies, has the advantage of heightening motivation, helping recall previous learning, providing new instructional stimuli, activating the learner's response providing systematic and steady feedback, facilitating appropriate practice, sequencing learning appropriately, and providing a viable source of information for enhanced learning. Teachers who use this system of instructional strategy would be able to kindle in the hearts of the learners a desirable attitude towards information technology tools in their entire way of life.

Murphy (1995) summarizes the learning outcomes that result from the use of technology in classroom as follows: (1) social growth, (2) problem solving, (3) peer teaching, (4) independent work, and (5) exploration. Technologies have played a dictating role in the field of education. Researchers have shown that technology when integrated into mainstream classrooms supports higher-level learning and thinking skills among students.

Tsou *et al*. (2006) found that ICT has positive effects in language learning, as it becomes an integral part of education and contributes as a teaching tool in the language classroom. There is a great deal of interest to learn more about the potential use of ICT in schools. Pelgrum (2001) identifies several reasons why technologies, in general and computers, in particular, might be important to schools. This include reasons relating to social and economic interests, such as reducing the costs of education, supporting the computer industry, preparing students for work and for living in a society permeated with technology, and making the school more attractive to its potential clients. Public initiatives have intended to spread the use of computer technology in schools by implementing computer laboratories and embedding actual classrooms with digital technologies to assist and support current classroom learning (Kozma, 2003).

The field of education in Nigeria has not been unaffected by the penetrating influence of information and communication technology (Yusuf, 2005). Undoubtedly, ICT has affected the quality and quantity of teaching, learning, and research in traditional and distance education institutions in Nigeria. In concrete terms, ICT can enhance teaching and learning through its dynamic, interactive, and engaging content; and it can provide real opportunities for individualized instruction. However, one wonders if ICT use is widespread in schools in the country, especially nursery and primary schools. It is important to expose primary school pupils to ICT at early stage particularly in the developing countries like Nigeria in order for them to be at par with their counterpart in the developed countries.

2.3. **ICT competencies**

Governments and education systems around the world recognise the need for students to be skilled, creative and confident users of a wide range of information and communication technologies (Brush *et al*., 2001; Charalambous and Karagiorgi, 2002; McNair and Galanouli, 2002; Rees, 2002; Richards; Voogt *et al*., 2000; Zhiting and Hanbing, 2002; Lim *et al*., 2004). ICT is evolving into a literacy in its own right alongside reading, writing and arithmetic (KCTR-CH Group, 2000). Students must master this literacy if they are to succeed within, and contribute to, a 'technology-savvy' future workforce (Wheelwright, 1999). Furthermore, given the potential that ICTs have to foster higher order learning outcomes (Steketeer *et al*., 2001; Jonassen, 2002), it becomes imperative that students are exposed to these new learning environments.

Children develop three types of competence: technical, cultural and learning. Technical competence refers to the ability to switch items off and on, and conduct other necessary operations for the desired activity. Cultural competence refers to children's understanding of the social roles which ICT plays, and their ability to harness ICT for a range of social and cultural purposes, such as communication, work, self-expression or entertainment. Learning competence is a subset of cultural competence, but one of particular significance to young children. In each case, the degree of competence children have acquired is dependent on a number of factors, including access to equipment, support in learning to use it, and the particular interests and aptitudes of older family members.

Children are expected to make progress in each of these strands, in terms of increasing knowledge, skills and understanding together with a broadening of contexts in which ICT is applied and a deepening of problems which are tackled (Kennewell *et al*., 2000) and teaching the different strands of ICT. Kennewell *et al*. (2000) suggest that it is important to develop each of the following components of ICT capability:

- Basic routines – operations which are carried out without significant conscious thought. Routines are primarily developed through practice.
- Techniques – simple procedures which still require a degree of conscious thought in order to carry out the correct steps to achieve a goal. However, with frequent, use such skills become routines. Techniques are primarily learned by copying a teacher or other pupils, or by trial and error.

- Concepts – the understanding which underpin knowledge of techniques and processes. Concepts are developed through verbalisation of activity and reflection on experience – particularly experience which is carefully structured by the teacher to engage the learner explicitly with examples and non-examples of the concept.
- Processes – multi-stage procedures for achieving specified goals. The particular techniques and sequence are not fully determined by the goal, and the user needs an understanding of both the goal and the tools available in order to make appropriate choices. Sometimes, the choice made will not produce the desired effect, and a different technique will be tried. Reflection on this 'mistake' can lead to learning which improves the user's ability to make an appropriate choice in the future. These are the skills described in the strands of the National Curriculum for ICT. Processes are developed by supported combination of techniques into multi-stage procedures in a range of problem situations, with an increasing degree of personal autonomy and active involvement on the part of the pupil.
- Higher order skills – knowledge of processes and techniques is not sufficient for successful application of ICT to problem situations: the pupil must also choose to use that knowledge, to monitor the progress being made, and to evaluate the solution gained. Higher order knowledge and skills are developed in an environment which encourages exploration when opportunities are presented to decide which software to use and how to use it, to make plans, to monitor progress during extended tasks, to evaluate and reflect on solutions and the contributions made by ICT. They are unlikely to be learned without significant teacher intervention and support.

Kennewell *et al*. (2000) further suggest that the importance of higher order skills and conceptual knowledge would require certain features of the learning environment for ICT. These features include:

- significant pupil autonomy in the selection of tools and resources
- active participation by pupils in the process of planning and evaluating the use of ICT in problem situations
- teacher intervention in the form of focusing questions to assist pupils in the formation of generalisations

- articulation of pupils' thoughts about the opportunities and constraints offered by ICT techniques, processes and strategies which they have experienced; articulation might be verbal, written or via email, but should be interactive

All students must have access to modern learning tools and challenging curriculum to move towards achievement of 21st century skills. Schools need to infuse these skills to meet community needs and students' expectations. One-to-one computing can provide a real-world, relevant education that can improve thinking and problem-solving skills and information and communication technology (ICT) skills. Teachers believe that students are more engaged and more motivated to learn, leading to higher-quality work. The environment facilitates more authentic, collaborative and project-based learning. (Swan *et al*., 2005) Today's students expect their school assignments to be relevant, challenging, and related to the real-world. They value problem solving, communication and the chance to collaborate as adults do in the real world.' (Barrios, 2004)

A comparison of regular classrooms and technology-rich classrooms suggest that pedagogical approaches are different. In a regular classroom, teachers spend more time giving instruction, leading discussions, asking and answering questions and managing the classroom; students spend more time asking and answering questions, working individually and as a whole group. In a technology-enabled classroom, teachers spend most of their time in demonstration, directing activities and talking to students; students spend more time working on projects, working in small groups, talking to and listening to other students. A technology-rich classroom provides opportunities for a more student-centred, project-based and small group oriented learning environment. Teachers must create instructional environments in which students use higher-order cognitive skills to construct meaning or knowledge, engage in disciplined enquiry, and work on products that have value beyond school (Barrios, 2004)

ICT provides students with frequent and immediate access to the Internet and educational software, placing technology in an integral position in relation to student learning and teacher instruction. There is wide access to resources to support student learning and tools to plan and organise learning. Students can communicate with their peers, teachers and the wider community and students can undertake collaborative tasks. This increased availability results in increased computer skills which potentially can transform the learning environment and improve student learning outcomes (Penuel, 2006). Dunleavy *et al*. (2007)

found that the 1:1 students to networked laptop ratio contributes generally and significantly to the effectiveness of the learning environments per the design criteria of being more learner-, assessment-, community- and knowledge-centred.' Students don't have to wait for teachers to convey information, as much of it is available on the Internet, forcing a focus on the changing role of the teacher. There are opportunities for differentiated instruction and engaging learning but only if we think differently about our learning environments (Owen *et al*., 2005). Integration of digital technologies into teaching programmes can expand the number of ways that students can learn. In the classroom, teachers become guides and partners in learning; students are the architects of their learning, with their computer acting as a toolbox. Teachers should use the most appropriate medium for the classroom activity. In a review about role and potential of ICT in early childhood, Rachel Bolstad (2004) found that studies suggest that ICTs can provide a useful context for co-operation and collaboration between children, and between children and adults. However, she asserts that educators "must be conscious of the kinds of learning interactions they would like to occur in the context of ICT use … and adopt pedagogical strategies to support these". Embedding ICT in educational settings diversifies the learning opportunities provided for children. However, as with any resources used in an early childhood setting, ICT alone does not improve learning: educators who use ICT wisely do. Children need to be active learners. The teaching strategies that educators employ need to reflect both responsive interactions and an appreciation of learning relevant to the 21st century.

2.4 GENDER AND ICT

The introduction of information and communication technology (ICT) into the educational sector created new social stereotypes and gender inequalities (Markauskaite, 2006). ICT-related activities have been viewed as a male domain for some time now (Brosnan and Davidson, 1996) or something for boys (Reinen and Plomp, 1996). In the past, a computer was primarily associated with programming and logical scientific thinking in schools. Thus, old stereotypic gender differences in attitudes and achievements that previously existed in mathematics and technological disciplines were extrapolated to the area of ICT. As several research reviews and meta-analyses summarised, boys were more interested in ICT than girls; they were heavier users of computers, had more positive attitudes about computers and consequently outperformed girls in their ICT literacy (Reinen and Plomp, 1996; Volman and Eck, 2001). It has become clear in recent years that observations about differences between groups of pupils regarding ICT should differentiate between the types of ICT application (Kay, 1992). Girls answer general questions about ICT attitude, for example, less positively than boys but are enthusiastic about applications like word processing and drawing (Volman and Van Eck, 2001).

There are also differences between males and females concerning how they judge their own computer skills and self–efficacy related to how to perform different ICT-related tasks. Males report being more advanced and more capable of dealing with what are identified as high-level ICT skills (such as downloading new software and programming) compared to women (Broos, 2005, CERI, 2010). Furthermore, males are reported to have wider computer experience, report greater interest in and positive attitudes towards computer-related activities, and even appear to be more motivated about learning digital skills (Broos, 2005; Selwyn, 2007; Smihily, 2007; Arnseth, 2007).

However, when there is evidence to suggest a gender-specific difference in attitudes towards ICT, in which boys reveal more confidence than girls, we do not know at what age this gender-based difference in attitudes starts. Several studies confirm no gender-specific differences in younger students. Some of these main findings are presented below:

- No considerable differences in respect of participation, ICT skills and learning between boys and girls in primary education (Volman *et al*., 2005).
- No differences concerning student attitudes, cognition or performance between boys and girls of elementary school age (North and Noyes, 2002; Mey, 2007; Kay, 2008).
- Boys are most likely to be well experienced in the use of video games for entertainment purposes at a very early age (Colley 2003). The use of computer games in schools seems to have a positive impact on engagement, and, in particular, on school dropouts, who very often are boys (Kirriemuir, 2004).

There seems to be a slight tendency towards boys displaying a preference for individual learning with ICT, whereas girls are more likely to prefer collaborative learning. Studies of Computer-Mediated Communication (CMC) and Computer-Supported Collaborative Learning (CSCL), claim that male dominance and gender differences in communication style continue to play a role even when CMC is characterized by its communicative capacity and, therefore, might be expected to be found more attractive to female students. Participation was more gender balanced in educational settings with an explicit focus on inclusiveness in collaboration (Prinsen, 2007).

It is equally believed that young people's gendered identities have an impact on future educational and career patterns, particularly in relation to science and technology, the two most crucial areas for knowledge economies (Vekiri, 2008, Geneve, 2009; Hill, 2010). In other words, youngsters' ICT preferences and patterns of use are influenced by socialization processes. The risks related to the use of ICT in relation to chat and Internet messaging constitutes an actual example in this case. To deal with it, parents are likely to impose rules on their children's usage. And parents' approaches to their children's use of ICT are gendered in several ways. Firstly, that they appear to lean on stereotyped views of boys' and girls' use of ICT; for example, by communicating safety and risk-related rules to the girls and rules concerning video games to the boys (Gannon, 2008; Lenhart *et al*., 2008; Medierådet, 2008).

The ICT sector is male dominated in general and this is also the case in terms of the design of software, games, diverse tools and gadgets according to Geneve, 2009; Prpic, 2009; and Hill, 2010. Some researchers have claimed that the maleness of design, not only in respect of the outlook, but also in respect of the kind of objects being developed might be one possible explanation on why girls do not feel attracted to this field. As a response to such a claim, several attempts to attract girls were conducted at the beginning of this millennium. For example, the development of the so-called pink games, which were designed to attract young girls to video games (Kirriemuir, 2004). However, the attempt failed. One explanation was that girls did not identify themselves as being "pink"; they just wanted other genres of computer games. Young people consider the Internet to be a highly important arena for socializing (Ito, 2008), but there are distinct gender differences in what boys and girls prefer to do. These differences also include geographical variations to some extent. In the Organisation for Economic Cooperation and Development (OECD) countries, research confirms that boys are more likely to show their preference for the practice of posting video clips on the web (Lenhart,2007; Taylor, 2010), and that girls dominate in other multimodal fields, such as weblogs and social networks (Lenhart, 2007; Medierådet, 2008).

However, there are overlaps between these activities as well as among countries. For example, in the UK it has been reported that girls are most likely to post video clips on the Internet (Luckin, 2008), whereas the situation was the opposite in the US (Taylor, 2010). A

Swedish survey showed that girls were more advanced in their use of mobile phones and the Internet than boys (Medierådet, 2008). Also the production of web-blogs is dominated by young people, and there are gender differences apparent in the content of such blogs, even if the blogging activity itself appears to be even between the genders. Males dominate the political commentary blog category, whereas women are in the majority in the personal diary category (Lenhart, 2007; Storsul *et al*., 2008).

There is evidence that boys dominate and show their preference for gaming activities, both at home and at school (Arnseth, 2007; OECD, 2007; Smihily, 2007; CERI, 2010). This interest in gaming appears to be most apparent in young boys, and there is a shift of interest as the boys grow older, in terms of a stronger focus on the use of ICT for educational purposes (Kent and Facer, 2004). What is striking is that young girls also appear to have an interest in gaming, not to the same extent as the boys, but they still play (Smihily, 2007; Aarsand, 2010). When girls do play, they avoid talking about games as "games". Instead they talk about the games by using game titles, like 'the Sims' (Carr, 2005). Both boys and girls consider gaming to be a male activity, with which the girls do not wish to be associated. The use of games in a pedagogical setting improves boys' attitudes and motivation towards education (Kirriemuir, 2004; Egenfeldt-Nielsen, 2006). On the other hand, the use of games for school-related purposes does not motivate girls with high marks (Kirriemuir, 2004). As for the educational use of gaming, so far, no clear effect has been established in academic learning (Egenfeldt-Nielsen, 2006). Still, there is evidence to suggest that games contribute towards improving general skills, such as collaboration skills, perceptual and motor learning, ICT skills and higher order-thinking skills, like problem-solving and strategic thinking (Kirriemuir, 2004). These several claims by researchers on gender and technology need to be further substantiated through research because of conflicting results.

2.5 Adoption and integration of information and communication technology into teaching and learning

Global investment in ICT to improve teaching and learning in schools have been initiated by many governments. Despite all these investments on ICT infrastructure, equipments and professional development to improve education in many countries, ICT adoption and integration in teaching and learning have been limited (Buabeng-Andoh, 2012).

Rangaswamy and Gupta (2000) describe adoption as the decisions that individuals make each time that they consider taking up an innovation. Similarly, Rogers (2003) defines adoption as the decision of an individual to make use of an innovation as the best course of action available. The process of adoption starts with initial hearing about an innovation to final adoption. Earle (2002) links ICT integration with the concept of wholeness, when all elements of the system are connected together to become a whole. For instance, the two important elements of teaching and learning which are content and pedagogy must be joined when technology is used in lesson. In other words, if students are offered series of websites or ICT tools (such as CD ROMs, multimedia, and so on) then the teacher is not integrating ICT into teaching since he/she is not tackling the pedagogical issues. Williams (2003) describes ICT integration as the means of using any ICT tool (the Internet, e-learning technologies, CD ROMs, and so on) to assist teaching and learning. One of the most valuable benefits of integrating ICT in school practice is that it enhances the possibilities of teaching and learning beyond the traditional limitations of time and space (Tubin *et al.*, 2003). ICTs greatly facilitate the acquisition and absorption of knowledge, offering developing countries unprecedented opportunities to enhance educational systems, improve policy formulation and execution, and widen the range of opportunities for business and the poor (Tinio, 2002).

Teachers are implored to adopt and integrate ICT into teaching and learning activities, but teachers' preparedness to integrate ICT into teaching determines the effectiveness of the technology and not by its sheer existence in the classroom (Jones, 2001). The attitudes of teachers towards technology greatly influence their adoption and integration of computers into their teaching. Anxiety, lack of confidence and competence and fear often implies that ICT will take a back seat to give room for conventional learning mechanisms (Russell and Bradley, 1997).

To successfully initiate and implement educational technology in school's programmes depends strongly on the teachers' support and attitudes. It is believed that if teachers perceive technology programmes as neither fulfilling their needs nor their students' needs, it is likely that they will not integrate the technology into their teaching and learning. Among the factors that influence successful integration of ICT into teaching are teachers' attitudes and beliefs towards technology (Hew and Brush, 2007; Keengwe and Onchwari, 2008). If teachers' attitudes are positive toward the use of educational technology then they can easily provide useful insight about the adoption and integration of ICT into teaching and learning processes. Demici (2009) conducted a study on teachers' attitudes towards the use of Geographic Information Systems (GIS) in Turkey. The study used a questionnaire to collect data from 79 Geography teachers in 55 different high schools. The study revealed that, although barriers, such as lack of hardware and software existed, teachers positive attitudes towards GIS was an important determinant to the successful integration of GIS into geography lessons. Research has shown that teachers' attitudes towards technology influence their acceptance of the usefulness of technology and its integration into teaching (Huang and Liaw, 2005).

Teachers' computer experience relates positively to their computer attitudes. The more the experience teachers have with computers, the more likely that they will show positive attitudes towards computers (Rozell and Gardner, 1999). Positive computer attitudes are expected to foster computer integration in the classroom (van Braak *et al*., 2004). For successful transformation in educational practice, user need to develop positive attitudes toward the innovation (Woodrow, 1992). According to Berner (2003), and Summers (1990) as cited in Bordbar (2010), teachers' computer competence is a major predictor of integrating ICT in teaching. Evidence suggests that the majority of teachers who reported negative or neutral attitude towards the integration of ICT into teaching and learning processes lacked knowledge and skills that would allow them to make "informed decision" (Al- Oteawi, 2002; as cited in Bordbar, 2010).

Access to ICT infrastructure and resources in schools is a necessary condition to the integration of ICT in education (Plomp *et al*., 2009). Effective adoption and integration of ICT into teaching in schools depends mainly on the availability and accessibility of ICT resources, such as hardware, software, and so on. Obviously, if teachers cannot access ICT resources, then they will not use them. Therefore, access to computers, updated software and hardware are key element to successful adoption and integration of technology. A study by Yildrim (2007) found that access to technological resources is one of the effective ways to teachers' pedagogical use of ICT in teaching.

Jones (2004) reported that the breakdown of a computer causes interruptions and if there is lack of technical assistance, then it is likely that the regular repairs of the computer will not be carried out, resulting in teachers not using computers in teaching. The effect is that teachers will be discouraged from using computers because of fear of equipment failure since no one would give them technical support in case there is a technical problem. Becta (2004) avers that "if there is a lack of technical support available in a school, then it is likely that technical maintenance will not be carried out regularly, resulting in a higher risk of technical breakdowns". Yilmaz (2011), in his assessment of technology integration processes in the Turkish education system, reported that, in providing schools with hardware and Internet connections, it is also crucial to provide the schools with technical support with regard to repair and maintenance for the continued use of ICT in schools.

Therefore, if there is no technical support for teachers, they become frustrated, resulting in their unwillingness to use ICT (Tong and Trinidad, 2005). A study by Korte and Husing (2007) revealed that schools in Britain and the Netherlands have appreciated the significance of technical support to help teachers to integrate technology into their teaching.ICT support in schools influence teachers to apply ICT in classrooms without wasting time troubleshooting hardware and software problems.

Although infrastructure support is imperative, school technology leadership is a stronger predictor of teachers' use of computer technology in teaching (Anderson and Dexter, 2005). Yee (2000) asserts that a leader who implements technology plans and also shares a common vision with the teachers stimulate them to use technology in their lessons. For effective utilization of ICT by teachers, there is the need for a strong leadership to drive well-designed technology plans in schools (Lai and Pratt, 2004). BECTA reports the effect of ICT on teaching in basic schools in United Kingdom also stresses the significance of good leadership (Lai and Pratt, 2004). In addition BECTA identifies five factors that should be present in schools if ICT is to be utilized properly. These factors were ICT resources, ICT teaching, ICT leadership, general teaching and general school leadership (Lai and Pratt, 2004).

The most important aspect of a good early childhood programme is its teachers, as classroom practices are influenced by teachers' beliefs. In other words, if teachers appreciate the role of computer technology in developing children's learning, they will be more likely to integrate technology into their early childhood programmes, and vice versa Hsiac (2003). In the view of Foote *et al*. (2004), "What teachers do is likely to be an outcome of their beliefs and knowledge about what is appropriate literacy for children in an early context". In a complex society like Nigeria, many factors affect ICT use and integration. So, an interdisciplinary and integrated approach is very necessary to ensure the successful development of Nigeria's economy and society (Mac-Ikemenjima, 2005). Positive teacher attitude is essential for successful implementation of the newly-introduced guidelines for technology integration in Nigeria (Ogiegbaen 2006). Pelgrum (2001) adds to this discussion knowledge from a worldwide survey of schools from 26 countries. He argues that among the main factors inhibiting the incorporation of technology in teaching and learning is the lack of knowledge among teachers.

2.6 Teacher perceptions of ICT in teaching and learning

A number of research initiatives which focused on teachers' and instructors' perceptions of technology use in education have been carried out recently. Research carried out in the United States by Brill and Galloway (2007) to examine lecturers' use of instructional technology and their perceptions of such technology found that instructors perceived technology to have had beneficial impacts on the instructional setting. He claims instructional technology facilitates the clear and elaborate presentation of information to students; enables the showing of numerous and complex examples; enhances the engagement/attention of students; encourages student-student and student-instructor interaction; and provides structure and support to the in-classroom experience. Instructors also discussed barriers to their use of instructional technology. These consisted of incompatible classroom environments and insufficient equipment to cater for needs of instructors.

Levin and Wadmany (2006) research into teacher beliefs and how they affect teacher practice within a technology-rich classroom environment has also added valuable knowledge to this area. They carried out a qualitative study of teachers within a school in central Israel that had recently implemented major changes in order to have technology-based teaching and learning. They found that teachers' beliefs regarding teaching and learning changed over three years within a technology-rich environment, and these changes manifested in modified classroom behaviour. They also found that as teachers' beliefs changed, so did their perceptions of how technology fit into the process of teaching and learning. For instance, the teacher belief that education was for the purpose of transmitting knowledge to passive learners in order to fulfil curriculum and policy requirements corresponded with views of technology merely as a support to that process. On the other hand, as this belief changed to a more constructivist orientation, teachers became more reflective of how technology could be used to enhance student engagement in the learning culture.

Furthermore, Levin and Wadmany (2006) point out that teachers react in varied ways to new ideas regarding the use of ICTs in teaching and learning, and may hold multiple views at once, which can and do change under the right circumstances. For some teachers in the study, their beliefs changed from a behaviourist orientation to a constructivist orientation. There were many supporting factors that may have made the difference in the development of teacher beliefs. The environment was already well equipped with the necessary technology in adequate quantities. In addition, the school developed a professional development strategy including mentoring of teachers; requisite support materials were provided; demonstrations of learning activities and research tools were carried out for teachers, and university personnel with expertise in educational technology and subject areas were available to mentor and assist teachers in implementing the reform (Levin and Wadmany, 2006). The above findings should be considered in conjunction with the support factors listed above, as evident in Levin and Wadmany's research (2006).

The theme of 'change in teacher beliefs' highlighted by Levin and Wadmany (2006) is also apparent in a study by Hennessy, Ruthven and Brindley (2005) of subject faculties of four English secondary schools with average access to technologies compared to national levels. The study aimed to find out how English teachers in secondary schools went about the process of integrating information and communications technologies in education. Although the research concentrated on English teachers' perspectives, it also included findings on the perspectives of Mathematics and Science teachers. The research found that teachers were generally committed to using ICT in the classroom although this was tempered by structural constraints, such as the availability of ICTs, as well as curriculum pressures embodied in examinations for which they had to prepare their students, as well as assessment regulations. Secondly, "while there was a feeling of inevitability and acceptance of the role of technology, the teachers simultaneously portrayed a reflective and critical outlook". That is, they expressed caution regarding the use of technology, in terms of undiscerning use, the need to keep learning goals uppermost, and the possible repercussions for subject cultures. An equally significant finding from the study was that the theme of 'change' was highlighted in teachers' discussions. Teachers were reflective of the changing context of teaching and learning and were responding with changes in pedagogy and thinking. They study concluded that English, Mathematics and Science teachers reflected on the place of technology in their subject areas, and were tried out new ways of teaching and learning that included technology. Henessy *et al*. (2005) recommended that teacher involvement should be at the centre of technology integration in teaching and learning rather than the technology itself.

Albirini (2004) provided a developing country's perspective in his study of Syrian teacher attitudes toward ICT. He argues that, while teachers have mostly positive attitudes regarding the integration of technology in schools, merely providing schools with technology will not achieve the changes mandated by government policy. He maintained that policy makers must be cognizant of the fact that educational reform will only happen if teachers have positive attitudes towards such a process. He implies that plans for the integration of ICTs in schools should take into account teacher perspectives regarding such reform. The present study would be interested to find out teachers perceptions of ICT in teaching and learning.

2.7 **The computer and young children**

The role of the computer within the learning environment concerns the way in which it is used in the teaching and learning processes. The computer may assist the teacher in instructing pupils, aiding pupils learning or being a tool to complete tasks. According to Bingimlas (2009), the use of computer in the classroom is very important for providing opportunities for students to learn to operate in an information age. Yelland (2001) argues that traditional educational environments do not seem to be suitable for preparing learners to function or be productive in the workplaces of today's society. Organisations that do not incorporate the use of new technologies in schools cannot seriously claim to seriously prepare their students for life in the twenty-first century. Grimus (2000) also asserts that by teaching ICT skills in primary schools, the pupils are prepared to face future developments based on proper understanding, which offers unique intellectual experiences and opportunities for young children.

Similarly, Bransford *et al*. (2000) aver that what is now known about learning provides important guidelines for uses of technology that can help students and teachers develop the competencies needed for the twenty-first century. Several researchers and theorist stress that the use of computers can help students to become knowledgeable, reduce the amount of direct instruction given to them, and give teachers an opportunity to help those students with particular needs (Iding *et al*., 2002; Shamatha *et al*., 2004; Romeo, 2006). Some schools have computer technology, with the ratio of computers to students changing from 1:125 in 1984 and 1:22 in 1990 to 1:10 in 1997 (Clements and Nastasi, 1993; Coley *et al*., 1997).

However, schools having computers does not mean children use computers. In one study, just 9% of fourth graders (they did not collect data on younger children) said they used a computer for schoolwork almost every day; 60% said they never used one. A study of preschool and kindergarten classrooms indicated low use by most teachers (Cuban, 2001). Nevertheless, there seems to be an increasing potential for children to use computers in early childhood settings.

An old concern is that children must reach the stage of concrete operations before they are ready to work with computers. Research, however, has found that preschoolers are more competent than has been thought and can, under certain conditions, exhibit thinking traditionally considered 'concrete' (Gelman and Baillargeon, 1983). Research also shows that even young pre-operational children can use appropriate computer programs (Clements and Nastasi, 1992). A related concern is that computer use demands symbolic competence; that is, computers are not concrete. However, this ignores the fact that much of the activity in which young children engage is symbolic. They communicate with gestures and language, and they employ symbols in their play, song, and art (Sheingold, 1986). What is 'concrete' to the child may have more to do with what is meaningful and manipulative than with physical characteristics. One study compared a computer graphic felt board environment, in which children could freely construct 'bean stick pictures' by selecting and arranging beans, sticks, and number symbols, to a real bean stick environment (Char, 1989). The computer environment actually offered equal, and sometimes greater, control and flexibility to young children. Both environments were worthwhile, but one did not need to precede the other. Other studies show that computers enrich experience with regular manipulatives. Third-grade students who used both manipulatives and computer programs, or software, demonstrated a greater sophistication in classification and logical thinking, and showed more foresight and deliberation in classification, than did students who used only manipulatives (Olson, 1988).

Some scholars argue that brain research indicates that children should not use computers (Healy, 1998). One could disagree with the interpretations of the research and its ramifications, but few neuroscientists believe that direct educational implications can be drawn from their field (Bruer, 1997; Cuban, 2001) – the implications are unwarranted and probably spurious.

Finally, recent reports bring up the old issue of 'rushing' children. However, computers are no more dangerous than many of the other materials we use with young children, from pencils to books to tools; one can push a child to read or engage in other activities inappropriately early. They can all also be used to provide developmentally appropriate experiences. The construct of 'developmental appropriateness' continues to be refined. Following the National Association for the Education of Young Children (NAEYC), we define it as follows: developmentally appropriate means challenging but attainable for most children of a given age range, flexible enough to respond to inevitable individual variation, and, most important, consistent with children's ways of thinking and learning (Clements *et al*., 1992). Therefore, the question is not if computers are 'concrete,' but whether they provide experiences that facilitate children's learning. Criticism (or proselytizing) not grounded in practice is unreliable. Researchers and theorists asserts that the use of computers can help learners to become knowledgeable, reduce the amount of direct instruction given to them, and give teachers an opportunity to help those students with particular needs (Iding *et al*., 2002; Shamatha *et al*., 2004; Romeo 2006). Base on the above findings scholars are still continuing to show interest in finding the correlation between young children and ICT acquisition.

2.8 Problems and prospects of ICT in education

The use of ICT in the classroom is very important for providing opportunities for students to learn to operate in an information age; it offers many means of improving teaching and learning (Lefebvre *et al*., 2006). The problems and progress of ICT in Education may assist educators to become successful technology adopters in the future. Owing to ICT's importance in society and possibly in the future of education, identifying the possible problems to the integration of these technologies in schools would be an important step in improving the quality of teaching and learning. Balanskat *et al*. (2006), argue that although educators appear to acknowledge the values of ICT in schools, difficulties continue to be encountered during the process of adopting these technologies. There are teacher-level and school-level constraints to ICT in educational programmes. Teacher-level constraints, inlude lack of time, lack of confidence and resistance to change; and so on while school-level constraints include lack of effective training in solving technical problems and lack of resources among others. Another view presents the problems as pertaining to two kinds of conditions: material and non-materials (Pelgrum, 2001). The material conditions may be insufficient number of computers or copies of software. The non-materials includes teachers' insufficient ICT knowledge and skills, the difficulty of integrating ICT in instruction, and insufficient teacher time.

Akinyemi (1998) asserts that there are numerous problems associated with using ICT in education in Nigeria. The problems are grouped into three sub-headings: finance, personnel and infrastructure. According to Abimbade (1997), the problems of using ICT in Nigerian schools include environmental, power, human resources, technological base, curriculum, pedagogy, finance and the like. It is also observed that power supply is another infrastructural problem; electricity failure has been a persistent problem militating against ICT application and use in Nigeria (Adomi *et al*., 2003; Adomi *et al*., 2004; Adomi, 2005). There is also the issue of the personnel to operate the systems and software developers. More people are also needed as operation managers, data analysts computer engineers and technicians. (Akinyemi, 1988; Abimbade, 1997). Finance is also one of the major problems of computer education in Nigeria. If all the stakeholders in education in Nigeria could allocate huge amount of money for computer education, computer education in Nigeria will get a boost.

Studies have shown that one's culture influences one's perception and learning. Most ICT software materials produced overseas are end products of research findings geared to solving specific problems in their country of origin. A major criticism leveled against these software materials is the unrelatedness of the educational materials sold to the Nigerian environment. In most cases examples and illustrations used have no relevance to the experience of the Nigerian children (Gana, 1982, cited in Wodi, 2009). As regards ICT software materials, Gana (1982) also provides reasons why they are considered "unsuitable for Nigeria. Some of the reasons are the sophistication in construction and operations of most of the equipment, the absence of adequately trained staff for maintenance and repair and the none – availability of spare parts for the different types of ICT equipment. Other problems identified by Dike (1994) include the problem of compatibility and standardization of equipment sold by different manufacturers. Finally, there is the problem of reliance on electricity as the major source of power for most of the ICT equipment with little regard to the fact that the equipment may be mostly needed in rural parts of Nigeria where there is no electricity.

Ajayi (2000) states that the rise of information and communication technology is an opportunity to overcome historical disabilities and once again become the master of one's own national destiny. ICT, is a tool that will enable Nigeria to achieve the goal of becoming a strong, prosperous and self-confident nation. ICT promises to compress the time it will otherwise take for Nigeria to advance rapidly in the march to development and occupy a position of honour and pride among nations.

The prospects of ICT are so numerous if used in a positive way. It enhances motivation and creativity when confronted by the new learning environments; promotes a greater disposition to research and problem-solving focused on real social situations; and encourages more comprehensive assimilation of knowledge in the interdisciplinary ICT environment. It also aids systematic encouragement of collaborative work between individuals and groups; ability to generate knowledge; capacity to cope with rapidly changing, complex, and uncertain environments; new skills and abilities fostered through technological literacy (Papert 1997). Kozma and Anderson (2002) claim that ICTs are transforming schools and classrooms by bringing in new curricula based on real world problems, providing scaffolds and tools to enhance learning, giving students and teachers more opportunities for feedback and reflection, and building local and global communities that include students, teachers, parents, practising scientists, and other interested parties. Similarly, Hepp, Hinostroza, Laval and Rehbein (2004) state that the roles ICTs play in the educational system can be pedagogical, cultural, social, professional and administrative.

i. *Pedagogical Tool Role:* ICTs provide a new framework that can foster a revision and an improvement of teaching and learning practices, such as collaborative, project-based and self-paced learning.

ii. *Cultural, Social, and Professional Roles:* The cultural, social and professional roles of ICTs are exercised primarily through an effective use of the vast amount of information sources and services available today via the Internet and CD-based content for the entire educational community: students, teachers, administrators and parents.

iii. *Administrative Roles:* ICTs have important roles to play in making school administration less burdensome and more effectively integrated to the official information flow about students, curricula, teachers, budgets and activities through the educational system information pipelines.

The literature is clear about the potential of ICT as a tool and catalyst to learning. ICT is projected and expected to help to create, collect, store, and use newly built knowledge and information. The use of ICT promotes the development of the skills needed in the information society, such as thinking skills and problem-solving skills. ICT is also positively associated with student achievement in a variety of knowledge domains (Schacter, 1999; Mc Guiness, 1999; Valdez *et al*., 2000; Waxman *et al*., 2003; Cox *et al*., 2004).

As Kozma and Wagner (2003) claim, ICTs can affect the pace at which the learning gap is bridged in developing countries, both domestically and in relation to other nations. The great challenge is to harness the advantages of those technologies in order to improve the delivery and quality of educational services, as well as to accelerate the rate at which knowledge is distributed and learning chances and outcomes are equalised throughout society (Wagner and Kozma, 2003). Technologies that are used for engaged learning and that support a challenging curriculum result in improved teaching and learning, increased student motivation to learn, and higher levels of student achievement. Consequently, ICT gives Nigerian youths the opportunity to compete on equal footing with their peers in other parts of the world. Conclusively, many problems pointed out above and many more are strong factors limiting ICT adoption in the teaching and learning process among third world countries.

2.9 Historical Background of LOGO Programming Language

Logo was developed by Seymour Papert at the Massachusetts Institute of Technology. Papert based the design of LOGO, which has been called all things, from a programming language to a philosophy of education, on the constructivism of Jean Piaget, whom he had spent some time working with in Geneva. Papert (1980) wanted to provide learners with an environment characterised by learners being in control of their own learning and engaged in powerful thinking about mathematical ideas. One aspect of LOGO, turtle graphics, was designed so that young children could use a transitory object, the turtle, to think with. He believed that this would enhance their cognitive development (Papert, 1980, 1985, 1986). Turtle graphics, thus constituted a "simple entry point" into computer programming much like baby talk is an entry point into speaking. The children can command the turtle to act out basic moves by telling it to go; *forward* and *back*, to turn *left* or *right* or to draw with a *pen down,* or not, with the *pen up.* These commands, together with an input number, make the turtle move and draw whatever the learner desires and, in the process, enables the child to engage in meaningful problem-solving activity (Nicola, 1995).

LOGO Programming Language was developed as a tool to foster the collaborative construction of knowledge (Papert, 1980). Murphy *et al*. (2002) found, in their review about promising educational software, including LOGO, positive results, especially in reading and mathematics. Cox *et al*. (2004), in an update of the ICT research literature, are in agreement with these results and point out that especially LOGO and subject-based mathematics software have clearly been linked to the attainment of higher test performance scores. The potential of LOGO has been extensively studied in the 1980s and the early 1990s. Most of this research focused on measuring learning outcomes, such as mathematics and geometry, the demonstration of metacognitive skills and cognitive skills, next to a strong focus on the acquisition of LOGO and programming skills (Chang, 1989; Valcke, 1991).

The following are identified as valuable cognitive outcomes of LOGO-use: higher levels of mathematical thinking (especially geometric thinking), a more generalized and abstract view of mathematical objects, a deeper conceptualization of fundamental concepts in geometry, and the development of problem-solving skills (Chang, 1989; Verschaffel *et al*., 1990; Clements, 1990; Cathcart, 1990; Enkenberg, 1990; Hoyles and Noss, 1990; Many, Lockard *et al*., 1991; Swan, 1991; Nastasi and Clements, 1992; Clements and Nastasi, 1992; Nastasi and Clements, 1994).

Despite the moderate positive claims about the cognitive effects of LOGO, there are also the findings that learning gains are not easily transferred to other knowledge domains or contexts (Dicheva, 1996). It was also argued that the benefits of LOGO and the transfer of skills acquired in LOGO-based learning environments were only to be expected after the pupils worked and learned with the environment for at least a year (Clements and Meredith, 1992). The actual time spent in practising high-level thinking skills and the frequency of this practice mediated by LOGO has been found crucial to further develop and transfer the skills (Morrison *et al*., 1999). De Corte (1993) stresses, as a result of his review of the research, that successful LOGO studies incorporated the following aspects: (a) a good balance of discovery learning with good systematic mediation and instruction; (b) direct instruction in problem solving skills within the Logo context; (c) a focus on specific skills to be developed (and a focus on measurement of these skills as a result of the LOGO-experience) and (d) the adoption of cognitive apprenticeship teaching approach.

The original LOGO-studies have been criticized owing to a number of methodological shortcomings. Too many studies were set up in artificial laboratory contexts (Verschaffel *et al*., 1990). The findings of studies were very inconsistent and not replicable, owing in part due weaknesses in the research reports, such as, lack of clarity, lack of conceptual precision, incomplete reports, too small sample sizes, the presentation of anecdotal evidence, and a high teacher/student ratio (Valcke, 1991; Wyatt, 1988). These issues limited the generalization of the findings. There was a clear need for a re-orientation in LOGO research. Scholars called for research of learning environments in more authentic school settings (Suomala, 1999) but the number of LOGO-research suddenly decreased and the research virtually stopped at the beginning of the 1990's. This is probably related to the too high implications of a projected integrated LOGO-use in schools. For instance, the computer/pupil ratio was at that time far too inadequate. Other limitations were related to the implications of integrated Logo-use for curriculum development, exigencies for teacher training, the implications at the level of current teaching practices and rigid characteristics of the school system (Valcke, 1990). LOGO-use entails the revision and expansion of traditional activities to incorporate objectives about higher-level thinking processes (Hoyles and Noss, 1990; Clements *et al*., 1992). Another apparent reason for the decrease in LOGO-related research is the advent of the Internet and the possibilities it opened for a reorientation in technology-related educational research. There is currently a revival in LOGO-research. The perspective introduced by the concept mindtools has re-animated the use of microworlds and LOGO-based environments. Newer versions of LOGO-based learning environments are available, and the software and technology has become more readily available in schools. Therefore, this is the right moment to research again the potential of LOGO-based environment, but now taking into account methodological critiques on LOGO and educational technology evaluation studies in general: (a) a focus on the overtime impact, (b) studies in naturalistic settings, (c) measurement of the impact on neartransfer tasks, (d) and control of instructional variables (Haertel and Means, 2000; Rumberger, 2000). A key element in this context is a shift in focus from outcomes measurement to process analysis of the outcomes of learning with LOGO.

In their review of the literature on the impact of LOGO programming on thinking skills and problem solving, Clements & Meredith (1992) assert that the research evidence to ground this assumption is less clear. But in general one of the more consistent research findings is that learners develop higher cognitive monitoring skills owing to LOGO experiences (Clements and Gullo, 1984; Lehrer and Randle, 1987; Miller & Emihovich, 1986). The researchers refer to the key role of the teacher to mediate the LOGO processes and the fact that the programming activities were based on a structured plan.

The collaborative nature of the LOGO tasks is expected to influence the cognitive selection, organization and integration processes (Edwards, 1998). The exchange of ideas, approaches, strategies, opinions, remarks, solutions, and critiques when developing LOGO-projects challenges the individual processing activities. This exchange creates opportunities for the learner to move to the next zone of proximate development (Vygotsky, 1986). Gaßner *et al*. (2003) note that it is due to the graphical nature of the LOGO as a mindtool that learners can externalize their thinking and share their "models" which they co-construct in the ICT environment.

2.10 Age and competence skills in LOGO

Age influence has been shown to exist in technology adoption contexts. Age was repeatedly found to have moderating effect on performance expectancy (usefulness), effort expectancy (ease of use), social influence, and facilitating conditions in many technology-related studies.

Work on children's computer programming began several decades ago at the Massachusetts Institute of Technology (MIT) Artificial Intelligence Laboratory, which later became the LOGO laboratory, when Seymour Papert developed a floor turtle that children could control using the text-based LOGO programming language (Bers, 2008). Recent research has shown that children as young as 4 years old can understand basic concepts of computer programming and can build simple robots (Bers *et al*., 2002; Cejka, Roger *et al*., 2006). Early studies with LOGO showed that when introduced in a structural way, computer programming can help young children improve visual memory and basic number sense, as well as develop problem-solving techniques and language skills (Clements, 1999). Works by

Papert (1980) and Resnick (1996) have also shown that learning how to programme may result in changes to the ways people think.

The LOGO language is an ideal medium for learning because it was founded and developed around the idea that the best learning takes place when the learner takes charge of his own learning. Based on Piaget's philosophy that children learn best through actively interacting with and exploring objects within their environment, LOGO allows even very young children to achieve mastery and control over the mathematically based computer world of the turtle. Because the LOGO language can be introduced to the child through the medium of turtle graphics, the child first becomes acquainted with computers and the concepts of programming through the analogy of drawing, an activity that most children enjoy and find to be engaging. Because young children can produce spectacular pictures (graphics) with LOGO, their motivation to learn and play with the language is usually very high, and not entirely dependent on their ability to read or write. Hence, their learning becomes personally meaningful and emotionally charged (Vaidya *et al*., 1985)

According to Vaidya (1983) and Vaidya and McKeeby (1984), using a developmentally appropriate language, such as LOGO, children can design computer programs to solve real problems and acquire knowledge that is transferable to other areas such as reading, communication, mathematics, and reading skills. Research has shown that the knowledge and concepts the children encounter during their interactions with the computer are transferable to their everyday experiences (Vaidya and McKeeby, 1984). In addition to the computer's potential to enable children to understand the world by giving them power to control and manipulate important features of a microworld, the computer can be used to encourage and promote effective communication and collaborative strategies among individual kindergarten children (McKeeby, 1984). Studies demonstrate that LOGO can be a powerful medium for preschool children to use in developing knowledge and building models about the world.

The potential of Logo has been widely and most of this research focused on measuring learning outcomes, such as mathematics and geometry, the demonstration of metacognitive skills and cognitive skills, next to a strong focus on the acquisition of LOGO-programming skills (Chang, 1989; Valcke, 1991).The following were identified as valuable cognitive outcomes of LOGO-use: higher levels of mathematical thinking (especially geometric thinking), a more generalized and abstract view of mathematical objects, a deeper conceptualisation of fundamental concepts in geometry, and the development problem-solving skills (Cathcart, 1990; Chang, 1989; Clements, 1990; Clements and Nastasi, 1992; Enkenberg, 1990; Hoyles and Noss, 1990; Many *et al*., 1991; Nastasi and Clements, 1994; Nastasi and Clements, 1992; Swan, 1991; Verschaffel, De Corte, and Schrooten, 1990). LOGO is a programming language which was specially written so that it could be learnt and used in an easy and natural way. It is an open-ended, general purpose, discovery-based programming language used by Papert and his associates to offer accessibility to a wide range of users, and to be used as a catalyst in the classroom. It provides children with the opportunity to learn about problem-solving strategies and mathematical ideas, and to use what they have learned as objects for future reflection (Subhi, 1999). Although it is very powerful and can be used for very sophisticated and complex programming, LOGO also has an easy and inviting starting point through controlling a turtle as a graphic on-screen. Primary-grade children have shown greater explicit awareness of the properties of shapes and the meaning of measurements after working with LOGO (Clements and Nastasi, 1993). There are many studies which have looked at the use of LOGO programming in schools, and the effects it can have on children's learning. These would appear to show that LOGO programming, in particular turtle-graphics, is an effective medium for providing mathematical experiences. When students are able to experiment with mathematics in varied representations, active involvement becomes the basis for their understanding (McCoy, 1996, in Maddux and Johnson, 1997).

Studies on LOGO programming indicate many positive effects for pupils. Reports indicate that pupils have more fun and are more enthusiastic, they have increased engagement in learning and are more interested in self-directed learning. Furthermore, they also have greater self- confidence, self-esteem and increase their problem-solving and critical-thinking skills. In addition, pupils' often enjoy spending more time working collaboratively and are more willing to share their work and help each other.

Kull and Carter (1990) argue that LOGO enhances children's problem solving skill on mathematical understanding. Students can explore numbers and number relationships by using the wrapping component of LOGO. Wrapping in LOGO occurs when a large number is entered into the computer, moving the turtle off the screen and back again as many times as commanded to produce a screen wrap. Young students are unable to appropriately associate numbers with their value. Students discover number relations by finding that if a larger number is entered into the computer, the turtle wraps longer and fills up the screen more than if a smaller number is entered. The children construct these wraps and determine that numbers represent a relational amount of something. After discovering number relation, students begin to predict what will happen on the screen with numbers they choose to input.

Battista and Clements (1990) investigated the changes in children's mathematical problem solving that resulted from learning LOGO. They found that understanding of geometric shapes was enhanced. Children's idea about mathematic problem solving became more sophisticated. Using LOGO led to geometry. Students practised and stimulated spatial relations, learning to repeat and rotate geometric figures on the screen. Battista and Clements avers that illustrating spatial imagery is important in geometric problem solving because it involves thinking about properties of figures. Determining how to recognize geometrical figures in their tilted form develops student's spatial imagery and visual reasoning.

Torgerson (1984) noted that Piaget's research stressed the necessity of student involvement in physical manipulation of objects to build intellectual structures. Children need to interact with their environment to understand spatial relations. The creating of geometrical shapes and designs provides practice in left, right, forward, and backward directions once they have developed the concepts of spatial relations.

Case studies appear to indicate that children exposed to programming profit intellectually (Papert, 1980). For example, measurable effects were found in the ability to estimate angles, which tended to transfer to another domain (Papert *et al*., 1979). Children appeared to bring structure to the use of numbers, and to utilize ideas in differential and coordinate geometry. Kull *et al*. (1984) observed first graders utilizing such mathematical notions as number, place value, estimation, standard units of measure, proportion, symmetry, inversion, compensation, and part-whole relationships.

One study with kindergarteners demonstrated an increase in numerical skills after LOGO programming (Hines, 1983). Directors of a research projects state that children working with Logo are learning to use concepts such as variables, coordinates, and angles; that they are able to make use of LOGO knowledge to make algebraic generalizations in a non-LOGO context (Noss, 1984); and that dramatic learning changes may be expected for as many as 10% of the students, this improvement being independent of a student's academic rank or social status (Fire Dog, 1984). One popular argument is that learning Logo will increase children's ability to solve problems. Papert (1980) has argued that the most beneficial learning is what he calls "Piagetian learning," or "learning without being taught." He has proposed that computers can make the abstract concrete and personal as they help children learn better by making their thinking processes conscious.

By programming the computer to do what they want it to do, children must reflect on how they might do the task themselves, and therefore, on how they themselves think (Papert, 1980). The claim is that children can create their own problems and then "stand back" and watch themselves, as embodied in the computer program, solve the problems. In this way, the LOGO programming environment holds the promise of being an effective device for cognitive process instruction-teaching how, rather than what, to think (Lochhead and Clement, 1979).

Gorman and Bourne (1983) reported that third-grade children who worked for one hour a week on LOGO programming performed significantly better on a test of rule learning than those with a half hour per week programming experience. Young (1982) claimed that more second-grade impulsive children in a LOGO treatment group shifted in the direction of reflective thinking than did impulsive children in a control group. However, no statistically significant relationship existed between the treatment and reflectivity posttest scores. Hines (1983) observed increased performance on Piagetian conservation tasks in five kindergarteners after LOGO programming.

In another context, Wright (1994) investigated children's exploration of shapes in a computer graphics environment. He found that children demonstrated sophisticated understanding of concepts about shapes and symmetry in this context and that the computer manipulatives afforded them the opportunity to play with ideas and transform objects on the screen. During the last two decades research has continued with young children and Turtle geometry (Clements, 1994; Yelland, 1995; Yelland & Masters, 1997; Yelland, 1998a, 1998b, 1999, 2002; Clements and Battista, 2002). It has revealed the ways in which young children are able to experience spatial and numeric concepts in new and dynamic ways in computer contexts. Geo-Logo (and Shapes) is computer software that is embedded in a mathematics curriculum called *Investigations in Number, Data and Space*. Explorations by young children in these environments have been shown to provide contexts in which children can engage with and demonstrate sophisticated understanding that is well beyond age expectations (such as Yelland, 1997, 1998a, 2001, 2002; Yelland and Masters, 1997). Research has indicated that when used in an open-ended exploratory way. LOGO can support the creation and maintenance of a good understanding of mathematical ideas. The importance of teacher scaffolding to support effective learning has also been demonstrated (Masters and Yelland, 2002). As Clements and Sarama (2003) aver "… research indicates that working with LOGO can help students to construct elaborate knowledge networks (rather than mechanical chains of rules and terms) for geometric topics" Early observational research suggested that LOGO drawing helps students create to pictures that are more elaborate than those that they can create by hand. They transfer components of these new ideas to artwork on paper (Vaidya and McKeeby, 1984). Such computer drawing is appropriate for children as young as three years, who show signs of developmental progression in the areas of drawing and geometry during such computer use (Tan, 1985; Clements and Nastasi, 1992). The foregoing findings, opinions and observations call for further investigations which this present study was out to do. Base on the above findings scholars are still continuing to show interest in finding the correlation between young children and ICT competence.

2.11 Gender and competence skills in LOGO

Research in the field of gender and education highlights a shift in the way we talk and conceive gender differences. Specifically, there is now evidence that boys and girls cope equally well with the curriculum. And even though during the 1970s and the 1980s one could discern noticeable patterns of girls' under-achieving in specific areas, such as mathematics and science, today the media 'sound bites' reverse the story and construct boys as having difficulties. Despite current debates on gender equality, computer use seems to remain a heavily gendered space. According to Volman and van Eck (2001), several international studies still point out significant gender differences in students' computer use at home and at school as well as in their beliefs about gender, technology, and computer learning. Although gender differences in many cases are small and their magnitude may vary by country (Janssen *et al*., 1997) or age (Volman *et al*., 2005), a consistent pattern emerges. Hutchinson and Whalen (1995) found that working with LOGO helped girls in grades 3 through 8 to solve some challenging mathematics and science problems, and to develop greater confidence in their problem-solving abilities.

Suomala and Alajaaski (2002) found that gender accounted for differences in complex problem-solving processes when a Lego Mindstorms environment was used. In the study girls demonstrated more cognitive conflict solution processes, more cooperation with teachers and more explicit planning. On the other hand, Wang & Ming-Zhang (2003) found that pupils' cognitive style was a significant factor in the demonstration of problem-solving skills among boys but not among girls.

There are many studies on gender differences in computer technology adoption and usage. Some researchers considered gender to be a main factor in the application of technology usage (Hu *et al*., 2003; Yuen and Ma, 2002). Gefen and Straub (1997) found that there were differences between females and males in the usage of computers, particularly concerning the use of e-mail. Venkatesh and Morris (2000) identified the significant difference between females and males in introducing a system for information retrieval. They found that men emphasized more on perceived usefulness in determining behavioural intention to use, while women regarded perceived ease of use as a more significant factor in determining behavioural intention to use.

Similar to age, gender is theorized to play a moderating role in IT/IS acceptance research. Gender was not included in the original Technology Accepted Model (TAM), but empirical evidence demonstrates that males and females have different perceptions about ease of use and usefulness toward information systems and thus have different system usage behaviour (Gefen and Straub, 1997). Research on gender differences indicates that men tend to be highly task-oriented (Minton and Schneider, 1980) and, therefore, performance expectancies, which focus on task accomplishment, are likely to be especially important to men. Women typically experience high levels of anxiety in using computers (Morrow *et al*., 1986) which could lead to lower level of perceived ease of use. Men's relative tendency to feel more at ease with computers has also been demonstrated in Information System(IS) literature (Gefen and Straub, 1997). Similar findings emerged in technology acceptance studies (Venkatesh and Morris, 2000; Venkatesh *et al*., 2003). As a predictor of intention in the short-run, men were more influenced by instrumentality, while women were more strongly influenced by social factors and environmental constraints; however there was, no significant gender differences in the determinants of technology use (Morris *et al*., 2005). Gender schema theory suggests that such differences stem from gender role and socialization processes reinforced from birth rather than biological gender per se (Kirchmeyer, 1997;

Lynott and McCandless, 2000). Recent empirical studies (e.g. Kirchmeyer 2002; Twenge, 1997) have also shown that gender roles have a strong socio-psychological basis and are relatively enduring, yet open to change over time.

In terms of gender influences over mobile phones use in China, the proportion of male users was 10% higher than that of the females in four major cities in China: Guangzhou, Beijing, Shanghai and Chengdu in 2001. As the mobile phones permeated rapidly into every corner of the cities, such a difference was rapidly disappearing (China mobile telecommunication market analysis: A report from consumers, 2005). Both genders tended to use the foreign brands. More males preferred to use Motorola (30%), and females preferred to use Nokia (25%) (Zhan, 2003). As the results of government-engineered gender equality, one-child policy in China, and the transition from a planning to market economy in China, fundamental socio-economic changes have taken place in that country in the form of pension arrangements, health care systems, welfare provisions, a higher level of women's education, urbanization, and increase in per capita income (Yang and Chen, 2004; Nie and Wyman, 2005). Those changes have most likely affected the demographic behavior patterns among urban, township and rural populations in that country. Urban daughters have more power than ever before to defy disadvantageous gender norms, while using equivocal ones to their own advantage (Fong, 2002). Consequently, the increasing equality between the two genders naturally reflects on their technology adoption pattern.

The literature on the imbalance of computer literacy of females compared to males (in favour of males) advances some ways of addressing the problem based on how each of the gender views the computer. Research indicates that male students are very interested in how technology works, while female students tend to focus on how the technology is used (Silver 2001). Teachers are reported to notice that boys seem happy to sit for hours with computers but end up playing computer games or messing around with the computer just to see what it can do. Girls, on the other hand, tend to want the computer to do something useful for them. This finding may suggest that girls will find the computer more attractive if it is presented as providing an easier or better way to do something they want or need to do (Women's Action Alliance, 2001). To stimulate the interest of all students, the context in which the computer is used should be relevant to their needs and interests. Its long-term usefulness in a variety of areas should be emphasized and connections to real world application made (Silver, 2001).

Research has revealed the dominance of males in computer use and ownership (Miura 1997, cited in Idowu *et al*., 2004). Studies that have examined the relationship between gender and computer attitude have reported that males tend to have more positive attitudes towards computers (Comber, 1997). The results of a computer competency test which included both theoretical and practical knowledge showed that girls were slightly less competent than boys (Bain *et al*., 1991). Jackson *et al*. (2001), in a comparison of female and male computer literacy competencies found that females reported more computer anxiety, less computer self-efficacy, and less favourable and less stereotypical computer attitude. A similar study by Francis and Katz (1998) found that gender stereotyping of computer use as a domain did not affect female students' attitude towards computer. This finding corroborates Smith and Necessary (1996), who also found that males had a higher level of computer literacy than females.

In looking at gender differences in a 7 week robotics course for high school students, Nourbakhs *et al*. (2004) found out that girls were more likely to have struggled with programming than boys and that girls entered the course with less confidence than their boys counterparts. However, it was also discovered that by the end of the course girls' confidence increased more than that of the boys (Nourbakhsh *et al*., 2004). Gender differences also emerge when children engage in programming. In one study, a post-test-only assessment seemed to indicate that boys performed better. However, assessment of the children's interactions revealed that the boys took greater risks and thereby reached the goal. In comparison, girls were keener on accuracy; they meticulously planned and reflected on every step (Yelland, 1994). Previous research by Yelland (1993) has found that when programming with LOGO, girls were less likely to take risks to achieve a goal than boys or boy/girl pairs. Although girls performed comparably to boys in the other programming challenges, they may have been less inclined to take risks in this advanced lesson. Programming in Logo and other languages has proved to help children (six to eight years) learn about complex phenomena (diSessa, 2000; Tholander *et al*., 2002) The present study, through further research investigates gender and competence skills in LOGO with a view to confirming or annulling the above several claims.

2.12 **Influence of school type in acquisition of ICT competence skills**

Within the field of school effectiveness research, the research on differences in effectiveness of different types of schools has taken a special position. Probably, few subjects within the sociology of education have created such controversies as the research on effectiveness of private and public schools.

The cross-national Programme for International Student Assessment (PISA) data that have recently become available allows us to address these questions in a broader international context. We build on the earlier study using the same data by Dronkers and Robert (2003), who examined differences in effectiveness between private and public schools across 19 comparable nations. Their main results were that the gross higher effectiveness of the private independent schools could be fully explained by their better social composition. But private government-dependent schools were more net effective than comparable public schools with the same students and social composition. The main explanation for this higher net effectiveness was the better school climate. These net effectiveness differences between public and private school sectors were equal across nations, despite the historical and juridical differences of their educational systems.

As a consequence of this latter result, we can argue that the various school sectors in these 19 comparable societies function in analogous ways. Within the educational systems of Western industrial societies, schools can be roughly categorized on two dimensions. The first is who takes decisions concerning the organization and curricula that schools provide. The second is who finances this education. In relation to the first issue, two types of schools have emerged in most Western countries. As a result of the struggle between the state and the established church, states have taken on the responsibility of organizing education. Here lies the root of public education that is fully governed and financed by public agencies (Archer, 1984). At the same time, however, for different reasons, schools have been established through private initiatives, as a result of the efforts of churches and other religious institutions, and also of ideological or commercial organizations. Although this type of school will often still have to comply with government regulations to a certain extent (partly also depending on the amount of financial support by the government, the crucial decisions regarding the school's affairs are made by private entities.

Within the private sector, schools can again be classified as either government-dependent or government-independent by the extent to which they are subsidized by the state. Subsidizing of private schools by governments is in many countries secured by law, either in the constitution (The Netherlands, Germany) or in common law (as in France, for example). In many cases, this right results from the claims of most religious groups to education based on the values and ideologies of the parents who are part of these groups, and who are considered to be responsible for the way their children are raised. Alongside these private government-dependent schools, there exist in a number of countries private schools that do not receive any government support that were mostly established for non-religious reasons by parents or organizations who have special pedagogical ideologies or societal aims. These schools finance themselves by means of pupil fees, donations, sponsoring, and the like.

Differences in effectiveness between schools could be explained by differences in the characteristics of pupils. Because private schools are more likely to demand pupil fees, they are more likely to attract pupils from the higher social-economic strata, resulting in better scholastic achievement on the average. The composition of schools regarding the background characteristics of the pupils plays an independent role: schools that have a relatively high number of ''good'' pupils will build up a good academic reputation that will attract better teachers (and even more good pupils), and there will be fewer factors that disturb the educational process; it will, for example, be less necessary to repeat the same subject matter over and over again than at schools that have a less favourable pupil composition.

Moreover, it is possible that private schools can provide better learning circumstances, such as a more extensive curriculum or fewer pupils per teacher. Third, differences related to school climate might explain differences in scholastic achievement between schools. In most countries (with Belgium, Ireland, and The Netherlands as obvious exemptions) public education is the standard for most, attending a private school will be the result of a deliberate choice made by the parents. It can be expected that the values and expectations of pupils at private schools will be more similar than those of pupils and teachers at public schools. This will, in turn, lead to a better school climate, including types of behaviour of both pupils and teachers that improve scholastic achievement. The study by Dronkers and Robert (2003) showed that several of these factors play significant roles. Differences in background characteristics and school composition effectiveness between public and private schools appear to be able to account for a large part of the effectiveness differences between schools, and can even explain the difference between public schools and private independent schools fully.

Eluwa (2005) also found that there are higher mathematics average scores for private schools than their counterparts in public schools. It is worth noting that private schools in Nigeria have more effective and efficient supervisory capacity than these public schools. There has been a boom in enrolment into private schools in Nigeria as the public schools system appears to have bowed to political and economic pressures. Okoyeocha (2005), in a comparative study of public and private schools in 22 schools (11 public and 11 private schools) in Nigeria found that public schools were better equipped than their private counterparts. The location of the school could also influence the level of academic achievement of pupils. Daramola (1985) found that pupils in urban schools performed significantly better than their counterparts in rural schools. According to Olatoye (2009) in Nigeria many public and private schools lack enough computer systems to teach and train students. Most research reports and review on computer education continue to come from developed countries. Many teachers are yet to incorporate Computer-Assisted Instruction into teaching. Many students who do not have access to Internet facilities in school make use of commercial Internet centres (cyber cafes) outside the school.

According to Westrup *et al*. (2003), public schools and institutions in most developing countries are facing the difficulty of managing and using the multiplicity of new ICTs, such as e-mail, voice mail, worldwide web, cell phones, and videoconferencing among others. In addition, the speed and ease of use of modern ICTs only serve to amplify these challenges. Hence, ICT is viewed as being ubiquitous in most schools and organizations. Since most public learning institutions and other public organizations progressively intents to expand into global markets, it is crucial for them to know how ICTs facilitate communication (Ross, 2001).

Several factors have been identified as hampering academic work and pupils' performance in public schools. For instance, Etsey *et al*. (2005), in their study of some private and public schools in Ghana, found that academic performance was better in private schools owing to more effective supervision of work. Thus, effective supervision improves the quality of teaching and learning in the classroom (Neagley and Evans, 1970). Also, the attitude of some public school teachers and authorities to their duties does not engender good learning process for the pupils. Some teachers leave the classroom at will without attending to their pupils because there is insufficient supervision by circuit supervisors. This lack of supervision gives the teachers ample room to do as they please. Another factor is lack of motivation and professional commitment to work by teachers (Young, 1989). This produces poor attendance and unprofessional attitudes towards pupils by the teachers, which, in turn, affect the performance of the pupils academically (Lockheed and Verspoor, 1991). Apart from all the aforementioned, most public schools lack adequate infrastructure and educational facilities. For instance, reading and learning materials are mostly hardly available, especially in rural areas. Also the size of each class forms a critical determinant of pupils‘ academic improvement and performance (Cochran-Smith, 2006). For example, Kraft (1994), in his study of the ideal class size, found that class sizes above 40 pupils have negative effects on pupils‘ academic achievement. This is because of the possible differences in interests and abilities of pupils, particularly in commanding attention in class (Asiedu-Akrofi, 1978).

Parents pay for the cost of educating their children in private school and therefore tend to be more involved in dictating what the school offers than parents whose children are attending public school (Agbatogun, 2009). Bagatsing (1996) noted that public school students, marginalized by their schools' lack of ICT facilities, are "in a predicament of competitive disadvantage. While private school students are on their way up the corporate ladder, their public school counterparts are continuously missing the bus". COSASE (2002) avers that public school pupils are not advantaged in terms of infrastructure. It has been observed by Goshit (2006) that most schools, both private and public, do not offer ICT training programmes. Many researchers agreed that equal access to computer technology will contribute to the closing of the digital divide when these children enter middle and high school. Employing discovery Logo with all children in a low-income classroom may have a positive effect on the already closing digital divide, whether it is a perceived divide between Whites and Blacks (ONLINE, 2003), rich and poor (Koretz, 2002), or urban and rural dwellers (Mills and Whitacre, 2003). These several claims by researchers on the influence of school type on pupils' competence in ICT has continued to arose the interest of researchers.

2.14 Computer Literacy and Competence Skills in LOGO

Computer literacy has been described as a basic skill required for success in many academic areas and career fields (Campbell, 1990). Winkle and Mathews (1982) define computer literacy as a basic survival skill involving the things the individual needs to know about and needs to do with computers in order to function completely and effectively in the society. Also, Simonson, et al. (1987) defines computer literacy as a combination of factors. The first is having a positive attitude including anxiety free, willingness or desire to use the computer, confidence in using them and a sense of computer responsibility. The second is the ability to responsibly evaluate, select and implement a variety of practical computer applications to do meaningful and efficient work based on an understanding of general types of applications, capabilities and limitations of types of applications, and societal impact of specific applications. The third is the appropriate knowledgeable use of hardware and software necessary for computer applications. The fourth is the ability to direct the operation of the computer through the skillful use of programming languages. From this definition, we could clearly see that computer skills are a big part of the requirements for an individual to be described as computer literate.

The world is seemingly experiencing a third wave of social and technological transformation as the society is becoming more oriented toward ICT, which is one of the various factors that are drastically influencing occupational success, especially in the educational sector. Faruque and Kasagga (2012) sees ICT as a set of technological tools and resources used to communicate, create, disseminate, store and manage information. The information dissemination is easily possible through computer technologies. Markauskaite (2006) opines that the introduction of computer technology into teaching and learning is a giant stride towards improving the quality of education. Globally, a new type of literacy that is more widely discussed is computer literacy. In fact, ICT (computer) literacy has been a subject of educational research ever since the integration of technology into education system either as a tool for self-study or as a teaching device.

Zeszotarski (2000) describes ICT literacy as the ability to use e-mail, graphical interfaces such as Netscape, online publishing and the ability to evaluate the content of online materials. Throwing more light on the concept, Idowu *et al.* (2004) view computer literacy as the ability to use computer system to word-process document, analyse data, develop small computer programmes, browse the Internet and install software. To Owen (1996), ICT literacy goes beyond the aforementioned. Apart from the basic knowledge and understanding of computers, he construes computer literacy skills to include being

- comfortable with the installation and configuration of common software.
- familiar with and making use of computer modem regularly.
- able to access a computer bulletin board or online service.
- able to send and receive messages via electronic mail
- able to upload and download computer files with ease
- to print from the computer.

According to Cambell (1988), the knowledge of computer in Nigeria has joined (or even surpassed) the knowledge of mathematics as a critical filter for employment opportunities. Also Compton *et al*. (2002) have predicted that the computer revolution will continue to have more ubiquitous impact on the lives of the individuals through economic, cultural and social institutions that affect society.

Computer literacy means knowing some basics of ICT to, for example, save and open a file, use a word processing program, and send and receive email for starters. Moreover, it means having some level of comfort around computers rather than having some fear or a feeling of foreboding (New York Times Company 2006). Idowu *et al*., (2004) indicate asserts that knowledge, skills and confidence with computer technology are now an asset for those entering the competitive employment market. Every aspect of life from education, leisure, and work environment to social interactions is being influenced by computer technology. Moreover, with the increasing use of ICT in education the world over, new skills and competencies among students are required for them to effectively learn. For example, there are avast array of services that one can currently find online. These services are constantly growing. Some of them are of a general nature, while others are specialised for students, such as reference information on the Web that students can find of use, include news, weather, sports, movies, encyclopaedias, cartoons and games among others. As an educational and entertainment tool, ICT can enable students to learn about virtually any topic, visit a museum, or play an endless number of computer games with other users. For students to exploit ICT resources, effectively, there is need to be equipped with the requisite digital literacy competencies.

Mason and McMorrow (2006) aver that there are two distinct components to computer literacy: awareness and competence. Awareness requires that a person has understanding of how computers affect his/her their day-to-day life as well as the larger society. Competence expects a person to be able to exhibit a hands-on expertise with a software application. Both of these components should be evaluated when looking at computer literacy within the classroom setting. Computer literacy is even thought to be as important as writing, reading, and mathematics in the school setting, as children in today's society have never experienced schools without computers (Robyler *et al*., 1993; Croxall and Cummings, 2000). These skills are essential in today's school systems, as more tasks are completed using computer technologies.

Eisenberg and Johnson (1996) state that computer literacy needs to include more than just the "how" of using computers; it also needs to focus on the "when" and "why." Through their research, they give some suggestions as to what computer literacy should cover. Some of their basic suggestions include being able to identify parts of the computer, creating drafts/final projects using a word processor, and using the Internet to search for information. The more advanced suggestions include knowing computer terminology, being able to operate and maintain a computer, having the knowledge to use instructional technology, having the skills to do various programming activities, and having a working knowledge of the impact of technology on society and all that society encompasses. Computer literacy is an important component in having the ability to successfully and confidently use technology (Eisenberg and Johnson, 1996; Croxall and Cummings, 2000). From the various views of research reports on computer literacy and ICT one can see that hardly will any enterprise possible without computer literacy.

2.15 Appraisal of the literature reviewed

Researchers have shown that children who use computers with supporting activities have significantly better developmental growth, compared to children without computer experiences, in terms of intelligence, structural knowledge, long-term memory, manual dexterity, communication skills, and problem solving (Haugland, 1992). Other researchers (Labbo and Ash, 1998; Clements and Sarama, 2003; Dodge *et al*., 2003; Morrow *et al*., 2003; Tancock and Segedy, 2004) have found positive relationship between the use of computer technology and children's literacy progress. Hutinger *et al*. (2002) argue that children's literacy skills increase as they work together at the computer. In addition, researchers have emphasized that technology, particularly computer-related technology, plays a fundamental role in improving teachers' instructional practices and, therefore, instruct pupils, aiding pupils learning or ability to complete tasks (Labbo and Ash, 1998; Lankshear and Knobel, 2003).

Children's computer programming began several decades ago at the Massachusetts Institute of Technology Artificial Intelligence Laboratory, which later became the LOGO laboratory (Bers, 2008). Recent research has shown that children as young as 4 years old can understand basic concepts of computer programming and can build simple robots (Bers *et al*., 2002; Cejka *et al*., 2006). Earlier studies with LOGO showed that when introduced in a structured way, computer programming can help young children improve in visual memory and basic number sense, as well as develop in problem-solving techniques and language skills (Clements, 1999). Young users of LOGO can engage in activities that Papert (1980) believed could enhance their cognitive development. This is in line with Gulek and Demirtas (2005) view that there is substantial evidence that using technology as an instructional tool enhances student learning and educational outcomes. Resnick (1996) has also posited that learning how to program may result in changes to the ways people think. Some observational evidence indicates that LOGO's most beneficial effects may be in the area of social and emotional development. Teachers claimed that through LOGO programming many students achieved a sense of power that is a source of self-esteem and self-confidence, and that they were less bored in the classroom and more enthusiastic about learning (Fire, 1984; Kull *et al*., 1984).

There are many studies on gender differences in computer technology adoption and usage. Some found that there were differences between females and males in the usage of computer, while others identified the significant difference between female and male in introducing a system for information retrieval. Some reported that there was no significant difference in computer usage means score based on gender. Studies have revealed that children in Piaget's pre-operational stage that, is 2 to 7-year-old children can understand basic concepts of computer programming because at this stage, children begin to represent the world with words, images and drawings. Reviewed literature also indicated that computer literacy is an important component in having the ability to successfully and confidently use technology. It has also been observed that there are discrepancies in school type, as some scholars believed that private schools performed better than their public school counterparts.

The review of related literature shows that computer programming has not been widely taught in primary schools in Nigeria because there is a general belief that computer programming is for adult. In addition, there is limited information in Nigeria on teaching primary school pupils computer programming using a developed Language of Graphics Orientation (LOGO) instructional package. Also, there seems to be no comparative studies of school type (private and public), pupils' achievement and computer programming. The researcher therefore finds this study necessary, as it would provide relevant information on influence of school type on pupils' achievement in computer programming in Nigeria. Review of literature on age and gender and computer programming seemed to be inconclusive because of disparity in results of some scholars. Another gap created in literature which this study would fill, is the investigation of age and gender on primary school pupils' in computer programming. This study stands to fill this gap by providing information on primary school children and computer programing in Nigeria.

CHAPTER THREE

METHODOLOGY

This chapter focuses on the methodology adopted in this work. It discusses in detail how the data were collected and analysed.

3.1 Research Design

The research design for this study is one group pretest-posttest quasi-experimental design in which there is no control group since there is no basis for comparism of any experimental group. The study was in two phases: the first phase was development of LOGO Instructional Package (LIP) using Kell's Model of curriculum design and the second phase dealt with using the package to determine its effectiveness. The second phase adopted one group pretest-posttest quasi-experimental design.

3.2 Procedure for Phase 1

Development of LOGO Programming Language Package (LPLP)

Kerr's Model of curriculum development from Urevbu (1985) was adopted for this study.

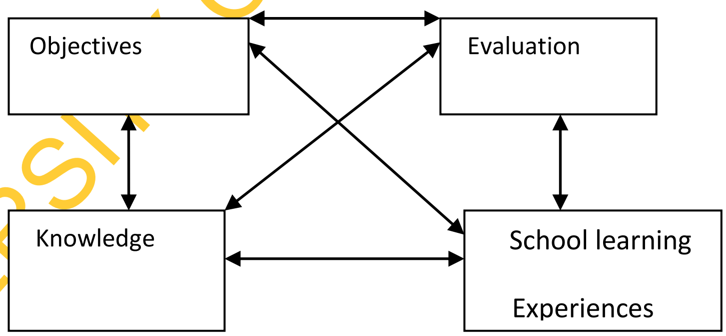


Figure 1: A simplified Version of Kerr's Model of Curriculum Design.

From Fig. 1, the four domains (objective, knowledge, evaluation and school learning experiences) are interrelated directly or indirectly and the objectives were derived from school learning experiences and knowledge.

3.2 **Phase II**

The second phase adopted one group, pretest-posttest design in which there is no control group. It also involved testing of the effectiveness of the package in terms of enhancement of pupils' competence in LOGO Programming. Participants were pretested on the LOGO Programming Language and thereafter exposed to the LOGO Programming Language Package. There was posttest after the pupils had been exposed to LOGO. Comparison of pupils' competence was then carried out along the following variables: age at four levels (A (5+ years), B (6+ years), C (7+ years), D (8+ years)), gender at two levels (male and female), level of computer literacy at two levels (low and high) and school type at two levels (public and private).

3.4 **Variables in the study**

The variables of the study are:

Independent Variable: Instructional Strategy using LOGO Package.

Moderator Variables: Age at four levels - (A (5+ years),B (6+ years), C (7+ years), D (8+ years))

Gender at two levels: male and female pupils

School type at two levels: public and private primary schools

Computer literacy at two levels: low and high

Dependent Variable: LOGO Graphic Competence.

3.5 **Measures of Competence in LOGO:** Pupils' acquiring knowledge and skills to perform a LOGO task or activity.

Task Skills	Being able to perform individual LOGO tasks.
Task Management Skills	Being able to manage a number of different tasks within the LOGO package
Environment Skills	Being able to deal with the responsibilities and expectations of the LOGO environment.
Mathematical Skills	Being able to draw different shapes and polygons using LOGO software

Adapted from: National Volunteer Skills Centre (2003)

3.6 Selection of participants

The population for this study was made up of teachers and pupils in public and private primary schools in Ibadan North Local Government Area of Oyo State. Two public and two private primary schools were purposively sampled for this study. In each school, 25 pupils in ages 5+, 6+, 7+ and 8+, were randomly selected. This gives the total number of 100 pupils per school but due to experimental mortality 349 pupils completed the study and eight teachers participated in the study. The criteria for the purposive sampling were:

a. availability of computer laboratory facilities in the public and private school;

b. the availability of computer teachers in each school.

3.7 Research Instruments

3.7.1 Instructional Guide on LOGO Instructional Package (IGLIP)

The package was designed by the researcher following Kerr's model of curriculum development. It is divided into 4 domains of performance objectives, contents activities (teacher and pupils activities), teaching and learning materials and evaluation techniques for each of the contents in the Instructional Guide. The instrument was used for teaching the pupils. There were 20 modules in the instructional guide. The package contained the step-by-step activities for pupils in each of the modules.

3.7.2 LOGO Programming Achievement Test (LPAT)

This instrument is self developed and constructed by the researcher. It was designed to measure pupils' level of performance and skill in each of the modules. The achievement inherent in this instrument is basically cognitive while the skills embedded task management, environmental and mathematical. The instrument has three sections: Bio-data which asked name, date of birth, name of school and respondent gender; section A asked pupils on LOGO content knowledge constructed on two option types while section B deals with LOGO graphic skills. The maximum score for LPAT is fifty marks, twenty for achievement test and thirty for graphics. The level of achievement of a pupil was taken to be the pupil's total test score.

3.7.3 Teachers' Perception Scale of the LOGO Instructional Package (TPSLIP)

The instrument was constructed the researcher. It consists of Section A which is bio-data and is made up of 5 questions which include gender, age, marital status, academic qualification and years of teaching experience in computer studies. Section B consists of 17 items which deal with the teachers' perception on LOGO Programming Language Package and has the options "Strongly Agree (SA)(4)", "Agree (A)(3)", "Disagree (D)(2)" and "Strongly Disagree (SD)(1)".

3.7.4 Challenges of LOGO Programming Instructional Package Usage (CLPLPU)

The CLPLPU was developed by the researcher by adapting School and Program Questionnaire, International Generic Version (OECD) questionnaire. It consists of 10 items to elicit information on challenges that teachers faced in the utilisation of the package.

3.7.5 Appropriateness and Utilisation Scale for Developed LOGO Instructional Package (AUSDLIP)

The AUSDLIP was constructed by the researcher. It asked the teachers questions about the appropriateness, utilisation, usage and suitability of the LOGO Programming Language. It consists of 15 items with yes and no option types.

3.7.6 Computer Literacy Scale (CLS)

The CLS was constructed by the researcher. This was designed to measure pupils' level of computer literacy. It consists of 20 items with yes and no option types.

3.8 Validation of the instruments

3.8.1 **Validation of the (IGLIP)**: The instructional guide was given to experts in educational technology, two primary school teachers and finally to the researcher's supervisor for correction on the suitability of the content, language of presentation and the usability of the modules. Their suggestions were used to improve the instrument. The LOGO instructional package was validated in a pilot study; results show that the package had a good face and content validity in term of its coverage sequence and appropriateness for the pupils as perceived by their teachers.

3.8.2 **Validation of the (LPAT):** It was given to some experts who examined the coverage of the instrument, phrasing of the items, depth of coverage and relevance to LOGO Programming Language Package; necessary modifications were made. For reliability, the test was administered to 20 primary school pupils. The item difficulty indices obtained ranged from 0.47 (47%) to 0.62 (62%) which shows that the instrument was neither too difficult nor too simple, while KR-21 value for reliability is 0.70.

3.8.3 **Validation of the TPSLIP:** The questionnaire was given to the researcher's supervisor and some experts who examined the depth of coverage of the instrument, phrasing of the items and relevance. For reliability, the questionnaire was administered to 20 primary school computer teachers outside the sample area and Cronbach Alpha was calculated to be 0.89 which implied that the instrument was reliable.

3.8.4 **Validation of the CLS:** The questionnaire was given to the researcher's supervisor and some experts who examined the depth of coverage of the instrument, phrasing of the items and relevance. The questionnaire was administered to 20 primary school pupils and split-half measure of reliability was calculated to be 0.72.

3.8.5 **Validation of the CLPIPU :** The questionnaire was given to the researcher's supervisor and some experts who examined the depth of coverage of the instrument, phrasing of the items and relevance. The questionnaire was then administered to 20 primary school computer teachers in the sample area and split-half reliability estimate was found to be 0.89.

3.8.6 **Validation of the AUSDLPLP:** The questionnaire was given to the researcher's supervisor and some experts who examined the depth of coverage of the instrument, phrasing of the items and relevance. The questionnaire was administered to 20 primary school computer teachers outside the sample area and the Cronbach alpha was found to be 0.75 when computed.

3.9 Procedure for the study

Phase one

Step 1: Conceptualization: to introduce LOGO to the existing curriculum in both public and private nursery and primary schools in Ibadan, Oyo State. Programming language was fundamentally missing. The need for LIP was conceptualised, in order to introduce programming language to primary school pupils in Nigeria to improve their creativity in computer studies. Very few schools were able to articulate a clear vision for computers and computing, or have a written plan with respect to the use of the equipment that they have.

Step 2: Identification of LOGO Instructional Package basic objectives

At this stage, the general objectives of LIP were identified based on the following factors:

(a) Society: The expectation of the society that pupils should be equipped with relevant skills in computer studies.
(b) Learners: The need of the learners in terms of programming, geometry, graphic orientation and development was also a factor. Also, the characteristics of the learners like age, interest, class, among were inherently considered in identifying LIP.
(c) Subject matter: The fact that the existing computer curriculum is lacking programming language in the content area also necessitated the introduction of LIP in this study.

Step 3: Designing the content knowledge and the whole package

At this stage, the four basic elements (components) of LIP were identified in a modular form. In the LIP, the structural arrangement of the curriculum components covered the modules, performance objectives, contents activities (teacher and pupils activities), teaching-and-learning materials and evaluation techniques for each of the content in the LIP.

Step 4: Try-out Stage and evaluation

This was the stage in which a tentative implementation of LIP on a small scale was done in order to validate it. Try-out stage was where the new curriculum and materials are tried out in a selected school in order to appraise their potentialities and suitability. The implementation with the pilot sample followed, two groups were used for the try-out stage one from preoperational stage (age 6 years) and the other group from concrete operational stage (age 8 years) (Huit and Humel, 2003). The groups were evaluated.

Step 5: Revision Stage

Based on some of the weaknesses and lapses that was observed during the try-out stage, LIP was revised before it was used for the preparation and training of teachers.

Step 6: Teacher Preparation/Training

The researcher organized training for teachers who implemented the LIP. The training covered: software application in the study; the purpose of the LIP and the research as a whole; basic explanation on the 20 modules of LIP and the general objectives expected to be achieved at the end and the evaluation techniques to be used in assessing the pupils' basic skills in programming language.

Phase two

The study followed the outlined sequence of activities:

1. Training of teachers: The researcher organized training for teachers who implemented the LIP. The training covered: software application in the study; the purpose of the LIP and the research as a whole; basic explanation on the 20 modules of LIP and the general objectives expected to be achieved at the end and the evaluation techniques to be used in assessing the pupils' basic skills in programming language.

2. Administration of Prettest: The second week was for the administration of the pre-test using LOGO Programming Language Achievement Test (LPLAT).

3. Administration of the LOGO Package: The LOGO Programming Language was divided into modules and, at the end of each module; there was an activity for

the pupils to do. The pupil who fell into the selected age groups were exposed to LOGO Programming Language through a LOGO Fable to sensitize them. Thereafter other modules were introduced to the pupils.

Duration of classes: Two terms in the three terms of 2010/2011 school calendar year were used (5 months). Details of each activity and module are as highlighted in Appendix A.

4. Administration of posttest: Post-tests were administered to all the age groups at the completion of the LOGO Instructional Package. The same instrument used for the pre-test was used for the post-tests. The post-test was for a period of one week.

3.8 Method of Data Analysis

The data collected were subjected to both descriptive and inferential statistics. The descriptive statistics used included frequency count, percentages, mean and standard deviation, while the inferential statistics included t-test and Analysis of variance (ANOVA). Research questions 1, 2, and 3 were answered using descriptive statistics of frequency count, percentage, mean and standard deviation while graphs were also used to answer research questions 4 and 5. Hypothesis 1, 2, 3, 4 and 5 were analyzed using t-test and Analysis of Variance (ANOVA).

CHAPTER FOUR

RESULTS

The results of the analyses are presented in this chapter. The research questions were first attended to, followed by the hypotheses.

Research Question 1: What is the perception of teachers on the use of the LIP in Nursery and Primary schools?

The response to this research question is presented in Table 4.1. Table 4.1 contains the perception of teachers on the use of LOGO Instructional Package (LIP) in Nursery and Primary schools.

S/N	STATEMENT	SA (4)	A (3)	D (2)	SD (1)	x̄	Std Dev
1	This software is easy to use.	6(75%)	2(25%)	-	-	3.75	.46
2	I am in control of the contents of the menus and toolbars	6(75%)	2(25%)	-	-	3.75	.46
3	I am able to learn how to use all that is offered in this programs.	6(75%)	2(25%)	-	-	3.75	.46
4	Navigating through the menus is easy to do.	6(75%)	2(25%)	-	-	3.75	.46
5	This package is tasking.	-	-	5(62.5%)	3(37.5%)	1.63	.51
6	The contents of the menus match my needs.	6(75%)	2(25%)	-	-	3.13	.35
7	Getting started with this version of the software is easy.	5(62.5%)	3(37.5%)	-	-	3.63	.52
8	Finding the options that I want in the menus is easy.	4(50%)	4(50%)	-	-	3.50	.53
9	It is easy to make the software do exactly what I want.	4(50%)	3(37.5%)	1(12.5%)	-	3.38	.74
10	Discovering new features is easy.	4(50%)	3(37.5%)	1(12.5%)	-	3.38	.74
11	I get my programming tasks done quickly with this software.	4(50%)	4(50%)	-	-	3.50	.53
12	Hardware problems often disrupt the lesson	4(50%)	1(12.5%)	1(12.5%)	2(25%)	2.88	1.36
13	Using LOGO instructional software to teach is expensive	-	-	5(62.5%)	3(37.5%)	1.63	.52
14	LOGO software makes lessons more fun.	3(37.5%)	5(62.5%)	-	-	3.38	.52
15	Using LOGO instructional package in my teaching is not enjoyable.	-	-	4(50%)	4(50%)	1.50	.53
16	LOGO instructional package makes the lesson more difficult.	-	-	2(25%)	6(75%)	1.25	.46
17	Using the software raises pupil's morale.	2(25%)	6(75%)	-	-	3.25	.46
Weighted Average = 3.00							

Table 4.1 shows that the teachers' perception on the use of the LIP was positive on thirteen out of the seventeen items listed. These are items 1, 2, 3 4, 6, 7, 8, 9, 10, 11, 12, 14 and 17. All the thirteen items yielded high mean scores (above 2.50 out of 4.00). Only four items obtained low mean scores (less than 2.5). It could be inferred from the teachers' responses that the programme is not tasking, not expensive and enjoyable and does not make the lesson difficult. On the whole, the weighted average of 3.00 out of 4.00 shows that teachers' perception on the use of the LOGO Instructional Package in Nursery and Primary Schools is that the programme is a welcome development.

Research Question 2: What challenges will Nigerian teachers face in using LOGO Programming Language in the classroom?

The challenges faced by Nigerian teachers in using LOGO Instructional Package were answered in Table 4.2

Table 4.2: Challenges in the use of LOGO Programming Language Package

S/N	ITEMS	Freq	%	Rank
1	Insufficient number of computers for teachers' use.	6	75	3
2	Insufficient number of computers for pupils' use.	5	62.5	6
3	Insufficient funds for purchase of equipment.	6	75	3
4	Teacher's lack of interest/willingness to learn LPLP.	1	12.5	9
5	Teacher's lack of expertise.	4	50	8
6	Lack of maintenance and technical staff.	5	62.5	6
7	It is difficult to integrate LPLP into classroom instruction practices.	1	12.5	9
8	No enough staff to supervise pupils' while using LPLP.	8	100	1
9	Problems in scheduling enough LPLP time different classes.	6	75	3
10	No time in teachers' schedule to explore opportunities for using the LPLP	7	87.5	2

From Table 4.2, eight of the ten challenges listed seems to constitute serious threats to the effective implementation of the LOGO Instructional Package in the schools. The most serious challenge is inadequate staff to supervise pupils' (item 8; 100%; Rank 1) followed by lack of time for teachers to explore the package (item 10: 87.5%; Rank 2). Also of serious magnitude are insufficient number of computers (item 1; 75%; Rank 3), insufficient funds to purchase equipment (items 3; 75%; Rank 3) and problems of scheduling enough LOGO programming Language time in different classes (item 9; 75%; Rank 3). Others include insufficient number of computers for pupils use (item 2; 62.5%; Rank 6), lack of maintenance and technical staff (item 6; 62.5% Rank 6) and teachers' lack of expertise (item 5; 50%; Rank 8). The two challenges which are not of serious dimension are teachers' unwillingness to learn (item 4; 12.5%; Rank 9) and difficulty in integrating LOGO Programming Language into classroom instructional practice (item 7; 12.5%; Rank 9). This pattern show that most of the listed challenges actually militate against the effective implementation of the LOGO Programming Language Package in the schools.

Research Question 3a: How appropriate is the Instructional Package for LOGO in terms of Age relevance?

The teacher's response to the appropriateness of the instructional package for LOGO in terms of age relevance is answered based on Table 4.3.

Table 4.3: Appropriateness of the Instructional Package for Pupil's Age
N = 8

SN	Statement	(Freq)	%
1	Package consistent with the way children learn and develop	8	100
4	The language is appropriate for the target group	8	100
7	Excitement and promotion of language acquisition	8	100
10.	The vocabulary, phrasing and sentence length are appropriate.	8	100
11.	The examples and graphics are appropriate for the age group.	8	100

Table 4.3 shows that all the teachers responded positively that the instructional package is appropriate for the age of pupils. The table specifically shows that all the teachers perceived that the package is consistent with the way pupils learn, used appropriate language, helped in

language acquisition, used suitable vocabulary, phrases and sentence lengths and employed appropriate examples and graphics.

Research Question 3b: How appropriate is the Instructional Package for LOGO in terms of Presentation of illustrations

The teacher's response to the appropriateness of the instructional package for LOGO in the presentation of illustrations is answered based on Table 4.4.

Table 4.4: Appropriateness of the Instructional Package in the Presentation of illustrations

SN	Statement	(Freq.)	%
2	The content is accurate and reliable	8	100
3	Package promotes active learning	8	100
8	Applicable to real-life situation	7	87.5
12	Progression of presentation is logical and well defined	8	100
14	The package added value or quality to the standard curriculum.	8	100

Table 4.4 on the LOGO Programming Language Package appropriateness in presentation of illustrations, shows that all the teachers involved in the study responded that the content accuracy (Item 2), promotion of active learning (Item 3), logical presentation (Item 12) and addition of value to the curriculum (item 14) are appropriate for the pupils. Also, 7 or 87.5% of the teachers also perceived that the package is applicable to real-life situations. Consequently, it can be inferred that the instructional package is appropriate in the presentation of illustrations.

Research Question 3c: How appropriate is the Instructional Package for LOGO in terms of Content sequence

The teacher's response to the appropriateness of the instructional package for LOGO in the content sequence is answered based on Table 4.5.

Table 4.5: Appropriateness of the Instructional Package in the Content Sequence

SN	Statement	N (Freq.)	%
5	There are some levels of difficulty and challenges.	7	87.5
6	The levels of difficulty and challenges add values to teaching and learning.	4	50
9	The information is well defined and structured to support teaching and learning	8	100
13	The package leads to the understanding of the nature of pupils' needs.	8	100
15	The package is initiating review of the curriculum	8	100

Table 4.5 shows that, in the aspect of content sequencing, all the teachers (N = 8; 100%) subscribed to the appropriateness of the LOGO Programming Language Package in its well-defined structure (Item 9) and ability to foster understanding of the nature of pupils' need (Item 13) and potential at initiating review of the curriculum (Item 15). They also claimed that there are some levels of difficulty and challenges (Item 5; N = 7; 87.5%) which adds values to teaching and learning (Item 6; N = 4; 50%). On this basis, the LOGO Programming Package was found to be appropriate in content sequence.

Research Question 4: At what age do public primary school pupils acquire competence in each of the 20 LOGO Programming Language Package Modules?

The multiple bar chart in Figures 1 and 2 answered research question 4 on age at which public primary school pupils acquired competence in each of the 20 LOGO programming language package modules.

Figure 2: Mean Scores of Public School Pupils in LOGO Competence (Modules 1-10)

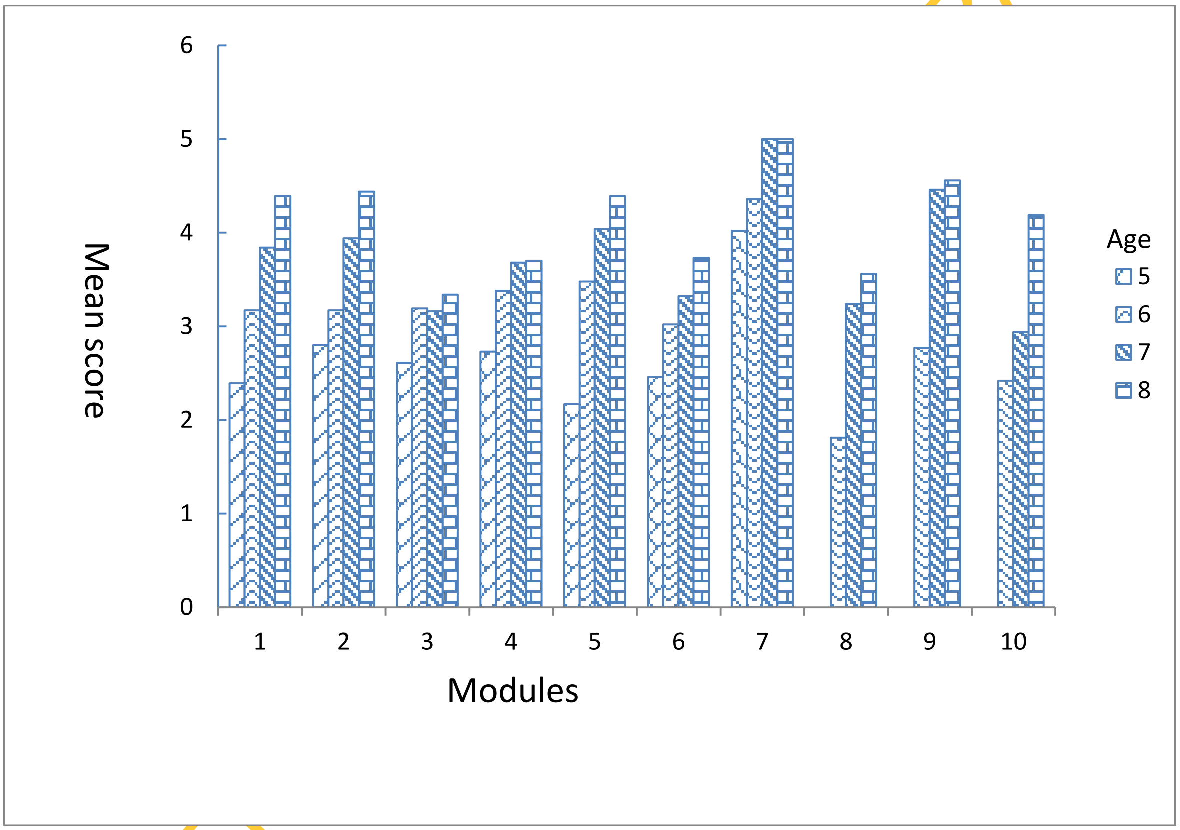
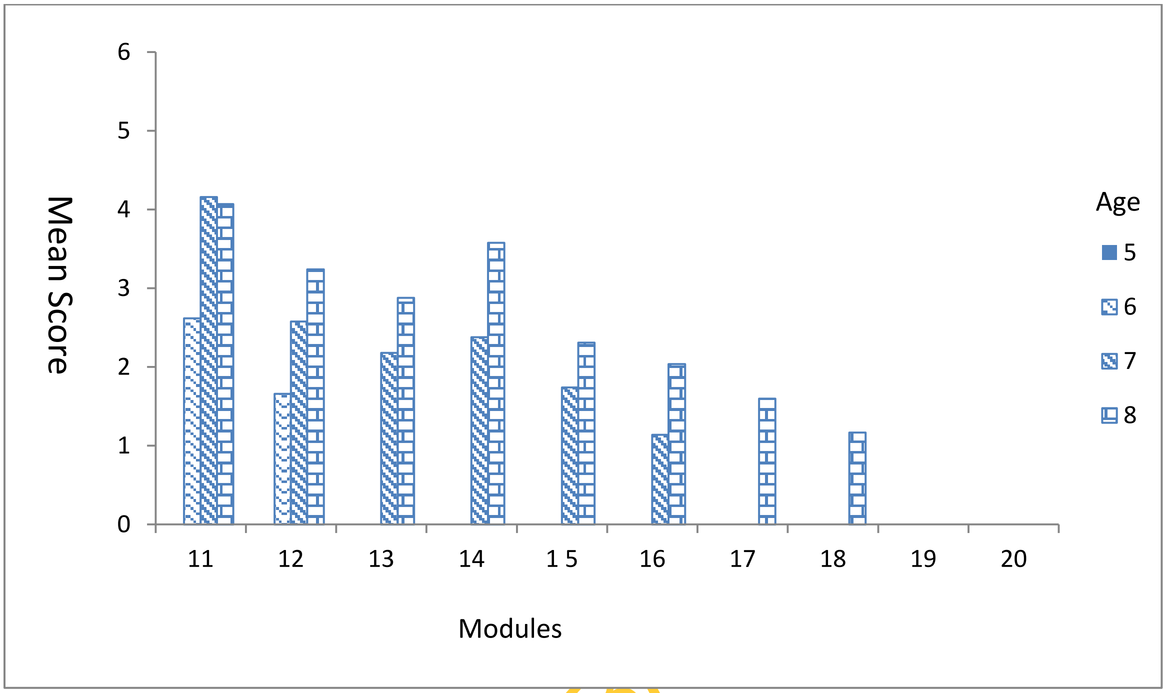


Figure 3: Mean Scores of Public School Pupils in LOGO Competence (Modules 11- 20)



As shown in Figure 2, this study revealed that all the age levels of public school pupils tested (5 to 8) obtained high mean scores, ranging from 2.39 to 4.44 on modules 1 to 5, with the exception of pupils within age five that had a lesser mean score of 2.17 in module 5 (see Figure 1). This same age (5 years) had the least mean score of 2.46 in module 6. This signifies improvement in their competence, with mean score of 4.02 in module 7. At the same age 5, they acquired no competence at all in modules 8 to 10, as shown in Figure 1. Pupils of age 6 had competence in modules 6, 7 and 9, with mean ranging from 2.77 to 4.36. This age level acquired low competence in modules 8 and 10. Other age levels (7 and 8) had high mean scores, ranging from 3.24 to 5.00 in modules 6 to 10 (Figure 1). Figure 2 further summarizes the competence level among all age levels in modules 11 to 20 for the public school pupils. The competence level of age 6 was high in module 11 ($\bar{x}$=2.62) after which it dropped to 1.66 in module 12 and subsequently to zero in all other modules (Figure 2). Age 7 also had relatively high competency in modules 11 and 12 ($\bar{x}$= 4.16 and 2.58) but the level of competence dropped thereafter till the last module. The highest age level tested (8 years) achieved competence up to module 14 ($\bar{x}$ = 3.58) while the level of competence acquired declined at modules 15 to 18 and no competence at all on modules 19 and 20

Research Question 5: At what age do private primary school pupils acquire competence in each of the 20 LOGO Programming Language Package Modules?

The multiple bar chart in Figures 3 and 4 answered research question 4 on age at which private primary school pupils acquired competence in each of the 20 LOGO programming language package modules.

Figure 4: Mean Scores of Private School Pupils in LOGO Competence (Modules 1 – 10)

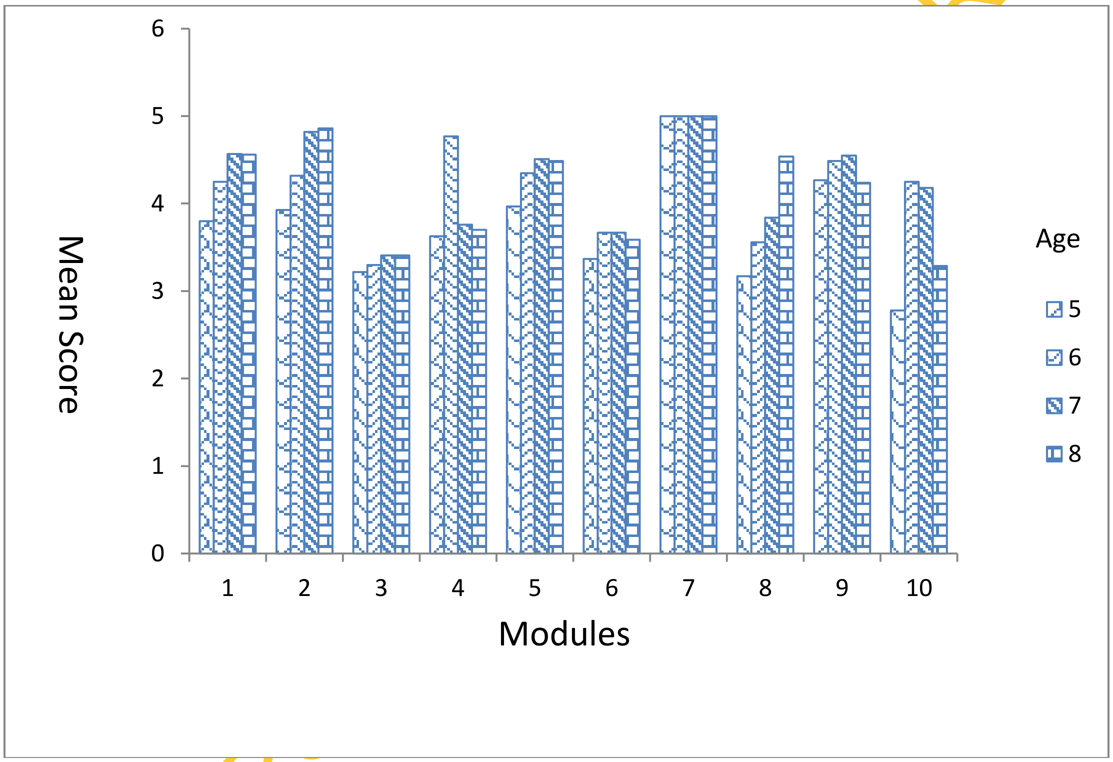
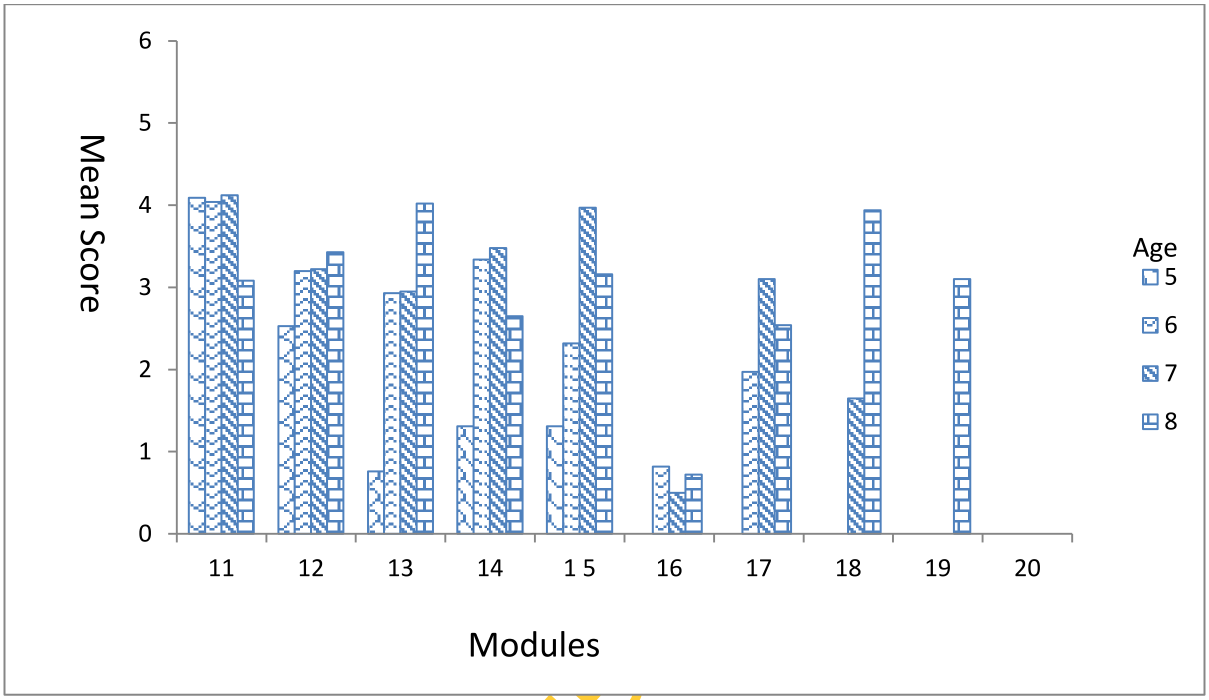


Figure 5: Mean Scores of Private School Pupils in LOGO Competence (Modules 11-20)



Figures 4 and 5 show that private school pupils of ages 5, 6,7 and 8 were able to acquire competence in modules 1-12, because their mean scores were between average and above 2.50 to 5.00. However, pupils of ages 6, 7 and 8 were able to acquire competence in LOGO Programming Language in modules 13 and 14, because their mean scores were between average and above ($\bar{x}$= 2.50 to 5.00). For modules 15 and 17, pupils of ages 7 and 8 acquired competence ($\bar{x}$ = 2.50 to 5.00). Modules 18 and 19 were only acquired by pupils of age 8 ($\bar{x}$ = 2.50 – 5.0). On module 19, there was competence for only age 8 ($\bar{x}$ = 2.50 – 5.0), no age level acquired competence in module 20.

Age in Relation to Modules Mastered

Modules	Contents	Age levels at which Competence is acquired in public schools	Age levels at which Competence is acquired in private schools
1– 4	Module 1: Let's get started. After completing the module, pupils were able to open Microsoft Windows LOGO and identify Microsoft Windows LOGO Software. Module 2: How to Exit LOGO. At the completion of the module pupils were able to open and exit Microsoft Windows LOGO software. Module 3: LOGO Turtle Graphics. At the completion of the module, pupils were able to Identify the turtle, Locate the turtle home position, hide the turtle and show the turtle again. Module 4: LOGO Opening Screen. At the completion of the module, pupils were able to Identify The Main Screen and The commander Window on the LOGO Opening Screen.	5, 6, 7 and 8	5, 6, 7 and 8
5 and 6	Module 5: LOGO Main Screen. At the completion of the module, pupils were able to identify the title bar, menu bar, drawing area and vertical scroll bar on the LOGO Main Screen Module 6: The Commanded Window. After completing this module, pupils were able to identify the commander window and use the component of the commander window.	6, 7 and 8	5, 6, 7 and 8
7	Module 7: The Input Box and Teaching the turtle to draw a CIRCLE: After completing this module, pupils were able to describe the Input box, enter and execute commands, draw different sizes of circles	5, 6, 7 and 8	5, 6, 7 and 8
8, 10 and 12	Module 8: Saving your work. After completing this module, pupils were able to save their pictures. Module 10: Turning Primitives in LOGO (Right/RT command). At the completion of this module, pupils were able to identify the position of the turtle, turn the turtle to the right side at different steps using RT command Module 12: Printing your Pictures. After completing this module, pupils were able to print their pictures.	6, 7 and 8	5, 6, 7 and 8
9 and 11	Module 9: Primitives/Commands in LOGO FORWARD and CLEAN Commands. At the completion of this module, pupils were able to apply the rules of giving commands in LOGO Programming Language, demonstrative the use of FD and Clean commands Module 11: Teaching the turtle to draw a SQUARE. At the completion of this module, pupils were able to draw different sizes of squares.	6, 7 and 8	5, 6, 7 and 8

Modules	Contents	Age levels at which Competence is acquired in public schools	Age levels at which Competence is acquired in private schools
13 and 14	Module 13: Opening your saved pictures. After completing this module, pupils were able to open their pictures. Module 14: Penerase/PE. After completing this module, pupils were able to demonstrate the command Penerase/PE and the command PENPAINT.	8	6, 7 and 8
15 – 20	Module 15: PenPaint. Pupils were unable to use the command **PENPAINT** Module 16: Teaching the turtle to use repeat and cleartext commands. Pupils were unable to use REPEAT command to draw different shapes, use the CT to erase. Module 17: Turning Primitives in LOGO Left/Lt. Pupils were unable to, turn the turtle to the right side at different steps using RT command Module 18: Teaching the turtle to draw POYGONS. Pupils were unable to draw different types of Polygons Module 19: Changing PEN Colour. Pupils were able to change the PEN colour Module 20: Letter Graphics in LOGO. Pupils were unable to use all the LOGO Primitives to make different designs and other graphics like alphabets	7 and 8 7 and 8 8 8 None None	7 and 8 None 7 and 8 8 8 None

Test of Hypotheses

$H_{o1:}$ There is no significant difference in the pretest and posttest achievement scores of primary school pupils in LOGO Programming Language.

Table 4.6 explains pupils' significant difference in the pretest and posttest achievement scores of primary school pupils in LOGO Programming Language.

Table 4.6: Pairwise t-test Comparison of Pretest and Posttest Competence of Pupils in LPL

Score	N	Mean	Std. Dev	Std. Error Mean	Mean Diff.	Std. Dev.	t	Df	Sig.
POSTACHV	349	27.88	8.98	.48					
PREACHVT	349	4.10	2.49	.13	23.79	8.29	53.56	348	.000*

***Significant at p < .05**

Table 4.6 shows that the pupils obtained a pretest mean score of 4.10 with a standard deviation of 2.49. However, at the posttest level, the mean score improved to 27.88 (SD = 8.98). This implies a positive mean difference of 23.79 and signifies a great improvement in the pupils' competence in LPL. The table also shows that the difference in the pretest and posttest competence mean scores is significant ($t = 53.56$; $df = 348$; $P<0.05$). To this end, the null hypothesis 1 is rejected and so there is significant difference in the pretest and posttest achievement scores of primary school.

$H_{o2:}$ There is no significant effect of age on pupils' competence in LOGO Programming Language

Table 4.7 shows the pupils' frequency distribution according to age, while Table 4.8 showed summary of Analysis of Variance (ANOVA).

Table 4.7: Descriptive Table for Pupils' Mean Score by Age

Age	N	Mean	Std. Dev.	Std Error
5.00	82	20.53	7.00	.77
6.00	90	26.96	6.97	.73
7.00	97	29.71	9.53	.96
8.00	80	34.20	6.19	.69
Total	349	27.87	8.98	.48

Table 4.7 shows that pupils of age 8 years has a higher mean competence score ($\bar{x}$ = 34.20; SD = 6.19) followed by those of age 7 ($\bar{x}$=29.71; SD = 9.53) and those of age 6 ($\bar{x}$ = 26.96; SD = 6.97), while pupils of age 5 had the lowest mean competence score $\bar{x}$ = 20.53; SD = 7.00). This implies that, as the age of the pupils increase, their level of competence in LIP improves.

Table 4.8: Analysis of Variance (ANOVA) Table for Competence by Age

Source of Variance	Sum of Squares	Df	Mean Square	F	Sig.
Between Groups	8017.69	3	2672.565	45.941	.000*
Within Groups	20070.00	345	58.17		
Total	28087.70	348			

*Significant at p<0.05

As captured in Table 4.8, the ANOVA shows that the F-ratio for the difference is significant ($F_{(3, 345)}$ = 45.94; p<0.05). Hence, hypothesis 2 is rejected. This implies that the pupils' competence in LPL is significantly different across age levels.

H_{o3}: There is no significant mean difference of male and female pupils' achievement in LOGO Programming Language.

Table 4.9 shows mean difference between male and female achievement in LOGO programming language

Table 4.9: T-test of Male and Female Pupils' Competence in LPL

SEX	N	Mean	Std. Dev	Std. Error Mean	t	df	Sig.
MALE	181	27.45	8.69	.65	926	347	.355
FEMALE	168	28.34	9.30	.72			

As seen in Table 4.9, the male pupils obtained a mean score of 27.45, while the female pupils had 28.34. This shows that the female pupils acquired higher competence than their male counterparts that are exposed to the LIP. However, this difference however, is not significant (t = .926; df = 347; p > 0.05). This hypothesis, is therefore, not rejected. This implies that there is no significant effect of gender on pupils' competence in LPL.

H_{o4}: There is no significant mean difference in achievement of pupils' with levels of computer literacy.

Table 4.10 shows indept t-test summary of competence of pupils' with low and high computer literacy on achievement in LOGO programming language.

Table 4.10: Independent t-test of Competence of Pupils' with low and high computer literacy

COMPLIT	N	Mean	Std. Dev	Std. Error Mean	t	df	Sig.
LOW	176	24.27	7.70	.58	8.26	347	.000*
HIGH	173	31.54	8.72	.66			

***Significant at p < .05**

Table 4.10 shows that pupils with low computer literacy obtained a mean score of 24.27 in their competence in LIP, as against 31.54 obtained by those with high computer literacy. This implies that pupils with high level of computer literacy acquired greater competence in LPL than their low-computer-literacy counterparts. This difference is also significant (t = 8.26; df = 347; p<0.05). This indicates that computer literacy determines the competence in LPL. Hence, hypothesis 4 is rejected.

H_{o5}: There is no significant mean difference of public and private schools in achievement in LOGO Programming Language.

Table 4.11 shows mean difference between private and public schools pupils' competence in LOGO programming language.

Table 4.11: t-test of Private and Public School Pupils competence in LPL

SCHOOL	N	Mean	Std. Dev	Std. Error Mean	t	df	Sig.
PRIVATE	170	31.56	8.80	.67	8.13	347	.000*
PUBLIC	179	24.38	7.68	.57			

***Significant at p < .05**

Table 4.11 shows that private school pupils had higher mean competence score ($\bar{x}$= 31.56; SD = 8.80) than their public school counterparts ($\bar{x}$= 24.38; SD = 7.68). This difference is also significant (t = 8.13; df = 347; p<0.05). Hence, hypothesis 5 is rejected, implying that there is significant mean difference in pupils' competence in LPL based on school type.

4.3. Summary of findings

The findings of this study are summarized below:

- Teachers' perception on the use of the LOGO software and LOGO Instructional Package in nursery and primary schools is very high.
- The Instructional Package is found to be appropriate for the age of the pupils as well as in the presentation of illustration and the content sequence.
- There is a significant difference in pupils' competence in LOGO Programming Language before and after exposure to the LOGO Instructional Package.
- The mean difference in LOGO competence of pupils with high and low computer literacy is significant.
- As the age of pupils' increase, their level of competence in LOGO Programming Language improves.
- All age levels tested in the public primary school acquired competence in modules 1 to 4. Pupils of ages 6 to 8 acquired competence in modules 5 and 6, all the age levels acquired competence in module 7 while pupils of ages 7 and 8 acquired competence in modules 8, 10 and 12. Pupils of ages 6 to 8 acquired competence in modules 9 to 11 only pupils of age 8 were seen to be competent in modules 13 and 14 while no pupil acquired competence in modules 15 to 20.
- In contrast, the private primary school pupils of ages 5 to 8 acquired competence in modules 1 to 12, ages 6 – 8 acquired competence in modules 13 and 14, while ages 7 and 8 acquired competence in module 15, and none of the age levels acquired competence in module 16. Surprisingly, ages 7 and 8 acquired competence in modules 17, while only pupils of age 8 acquired competence in modules 18 and 19. No pupil acquired competence in module 20.
- The mean difference in LOGO Programming Language competence of pupils in public and private schools is significant.
- There is no significant mean difference of gender on pupils' competence in LOGO Programming Language.

- The challenges listed actually mitigate against the effective implementation of the LOGO Programming Package in both public and private primary schools with insufficient staff to supervise the pupils ranking the highest challenge.

CHAPTER FIVE

DISCUSSION, CONCLUSION AND RECOMMENDATION

The chapter discusses the findings and gives recommendations based on the findings.

5.1 Perceptions of teachers on the use of LOGO software package

This study, found that LOGO was child friendly, not difficult but easily accessible but enjoyable and could be learnt and used in an easy and natural way. This is line with the findings by Cox *et al*. (1999). This is because all the factors the teachers considered as making it easy to use ICTs are considered according to Cox *et al*. (1999) to be the factors contributing to the continuous use of ICT by teachers in their study. The factors are making the lessons more interesting, easier, more fun for them and their pupils, more diverse, more motivating for the pupils and more enjoyable among others.

Also, teachers found it easy to demonstrate to the pupils how they can command the LOGO turtle to move and make different shapes and designs. This is in line with the observation of Rafiu (2009), that if teachers are guaranteed total access and freedom to experiment with the use of computers as teaching tools, there will be a reciprocal outcome of computer experience that provides the technical know-how and the intellectual ability to manipulate and discover the pedagogical power of the computer. By extension, it would aid teachers' methodology and teaching, while pupils will be eager to use LOGO software to make different designs. This will aid the learning of the software. Baylor and Ritchie (2002) argued that, regardless of the amount of technology and its sophistication, technology will not be used unless teachers have the skills, knowledge and attitudes necessary to infuse it into the curriculum. The report by Gordon University Aberdeen (2004) that teachers were reasonably confident in their use of ICT but felt that they needed much more in the way of support and professional development to maximise their use of ICT in the classroom support the present findings. Therefore, it is important for future teachers to be equipped with what is needed to help them integrate ICT technology into their teaching (Penuel, 2006).

Teachers also indicated that pupils are more engaged and more motivated to learn in LOGO environment, leading to higher-quality work. This is line with the finding of Swan *et* *al*. (2005) that environment facilitates more authentic, collaborative and project-based learning. Barrios (2004) asserts that 'only through professional development and with the support of the school leadership can technology changes in the classroom occur.' Teachers now realize that computers and other ICT facilities can enhance teaching and learning because, according to Dunleavy *et al*. (2007), teachers have greater opportunities to individualise instruction in a learner-centred environment. Also, the selected primary school teachers were encouraged regarding the computer efforts. Some teachers participated in after school computer classes conducted by the researcher, indicating more than a casual interest in the work. Head Teachers visited the computer laboratory frequently and asked about the work. Parents who were not frequent visitors in the school, visited the school to ask about the program, and expressed their interest in introducing LOGO programming into the school programme. Essentially, the schools demonstrated interest in computer education and offered support for the present study.

5.2 Some challenges in the use of LOGO Programming Language Package

The challenges militating against the use of LOGO Programming Language Package include lack of adequate staff to supervise pupils and insufficient time for teachers to explore the package. Marshall *et al*. (2003) and Silica (2005) reported similarly that the most common challenges reported by all the teachers in their study was the lack of time they had to plan technology lessons, explore the different Internet sites, or look at various aspects of educational software. While this has been interpreted to mean that staff have not had the time to acquire the necessary skills in the use of technology in teaching, it now seems more likely that it reflects a sense of priority conveyed by the institution and a desire by academics to see a return on the investment of their time in developing their teaching delivery with technology.

In this study, insufficient number of computers was also found to be a great challenge. Agbetuyi (2012) concluded that the vision to make Nigeria an ICT capable country in Africa is yet to be achieved. This is because several challenges are responsible for its full actualization. These challenges include poor IT infrastructure, inadequate ICT manpower, epileptic power supply and high cost of ICT facilities among others. Also, research confirms that ICT development and application are not well established in Nigeria because of poor information infrastructure (Adomi, 2006). It has been reported that more than 40 percent of the population of Africa is in areas not covered by telecom services

(Southwood, 2004). Therefore, schools located in such areas will experience ICT connectivity problems.

Toprakci (2006) also discovered that low number of computers, oldness or slowness of ICT systems, and scarcity of educational software in schools were barriers to successful implementation of ICT. This is in line with Reynolds, Treharne and Tripp's (2003) claimed that there was insufficient government investment in the development of the subject and not enough structure and support for how the subject was taught. According to Gulbahar (2005), using up-to-date hardware and software resources is a key feature to diffusion of technology. Inadequate funds to purchase equipment was also a major challenge as teachers claimed that government does not provide funds to purchase the equipment. This led to the problems of scheduling adequate computer time in different classes. Mumtaz (2000) also states that many scholars proposed that lack of funds to obtain the necessary hardware and software is one of the reasons teachers do not use technology in their classes. A number of researchers have identified time limitations and the difficulty in scheduling enough computer time for classes as a barrier to teachers' use of ICT in their teaching (Beggs, 2000; Al-Alwani, 2005; Schoepp, 2005; Silica, 2005).

Another challenge observed in this study was lack of technical staff that can deal with maintenance issues and resolve technical problems which hinder learning. Pelgrum (2001) found that in the view of primary and secondary school teachers, one of the top barriers to ICT use in education was lack of technical assistance. Silica (2005) also found that technical barriers impeded the smooth delivery of the lesson or the natural flow of the classroom activity. According to Tella *et al*. (2007), lack of ICT technical support may be attributed to limited number of people who are professional in the use of ICT equipment, coupled with the fact that integration of ICT in the school curriculum in Nigeria and Africa generally has just begin. People just beginning to develop interest in the area and take it as a chosen field of study. It is assumed that, with time, more experts and ICT technicians will begin to emerge. When planning introduction of new technology or when it is being used, technical support or support services generally are very important. The finding is consistent with that of National Center for Education Statistics (2000), which identified common challenges faced by teachers in their efforts to integrate technology into their curriculum as (1) adequate time to identify and learn compatible and relevant software; (2) scheduling of access to computers; (3) adequate equipment and use; and (4) adequate and timely professional development.

In addressing some of these challenges, the teachers demonstrated a lot of initiatives. For example, in schools where they did not have sufficient computers, the teachers drew the software interface on the chalkboard to explain the parts of the software and their uses, to show the pupils the home position of the turtle and to demonstrate the movement of the turtle to the pupils before they were engaged in the computer activities. This initiative influenced pupils' ability to ask questions, figure things out, plan ahead, develop self-reliance and approach the computer activities in a flexible manner, all for learning to take place. However, the challenges should not stand as an obstacle to teaching programming at primary school levels because they can be addressed continuously in the process of teaching and learning.

5.3 Appropriateness of the Instructional Package for Pupils' Age Level

All the age levels were introduced to LOGO fable by their teachers to ensure that they all had positive beginning and to prepare them for the training. Some pupils approached the computer eagerly and they were ready to further explore the content of the programme, while others, especially in the public schools, were hesitant and intimidated by this new experience. Those that were hesitant were directed and supported by their teachers to make sure that they made an informed decision to use the computer for learning. Initially, pupils were set in groups of three to five on a system and teachers helped them with the hand-on activities during the training sessions. The teachers perceived that the Instructional Package was appropriate for the age of pupils. Although Vail (2001) is of the view that there is a risk that computers will result in some number of negative effects on child development such as social isolation, lack of imagination, repetitive, stress injuries, poor concentration and even poor language and literacy skills, this study reveals that the pupils expressed enjoyment when exploring LOGO environment, interacted with their peers, engaged in group problem solving, eager to show their programming projects and creativity. This is supported by Genishi (1988), who claims that the pupils were eager to cooperate and share what they have learned with others. It also helped students to be creative (Vaidya and Mckeeby, 1984); students engaged in more self-directed explorations and show more pleasure at discovering phenomena (Clements and Nastasi, 1985; Clements and Nastasi 1988).

LOGO is a child-friendly programming language. It offers easy entry into the world of programming for young children. It involves a very simple command, as a child needs only three or four commands to direct the computer to draw different shapes on the monitor. Thus, as the child is able to understand the simple commands in LOGO, LOGO has the capability to translate these concepts into programs. For example, a circle can be drawn by a series of small movements and small turns, in many steps or it can be drawn in one step by telling the computer what a circle is and then telling it to go ahead and draw one. The pupils were encouraged to use the computer and to interact with the turtle to make their designs for teacher's assessment. According to Selwyn and Bullon (2000), younger children tend to unconditionally express a preference for using the computer across all activities, usually for practical, process-focused reasons. This is in line with Zucker and Hug's (2007) opinion that teachers using computers for assessment believe that they provided more timely, detailed and complete feedback to students. They stated that as the students' products were electronic, they were easier to assess.

5.4 Appropriateness of the presentation of illustration and content sequence

It was found in this study that the LOGO Instructional Package is appropriate in the presentation of illustration and content sequence. It is well structured. It has the ability to foster understanding of the nature of pupils' needs and potential at initiating review of the curriculum. Research has shown that the effectiveness in the use of ICT to support learning is a function of the curriculum content and the instructional strategy such that, when appropriate content is addressed using appropriate strategies, students and teachers will benefit (Cradler and Brigforth, 2002). Also, according to Gulek and Demirtas (2005), there is substantial evidence that using technology as an instructional tool enhances student learning and educational outcomes. Teachers also claimed that there were some levels of difficulty and challenges which added value to teaching and learning. According to Owen, Farsail *et al*. (2005) teachers need to believe that technology can transform teaching and learning into a current, relevant and highly engaging experience for students.

5.5 Public school pupils' competence in the modules by age

Findings of this study showed that all age levels in the public primary schools acquired competence in modules 1 - 4. Age 5 pupils were able to open Microsoft Windows LOGO, exit LOGO software, identify LOGO Opening Screen. They were able to identify the input box and command the turtle to draw different sizes of circle, in which all the pupils demonstrated 100% competence. The result of this study is in agreement with the assertion of Maddux and Rhoda (1984) that the philosophy behind LOGO was to enable the youngest and most computer illiterate students to do something interesting with the computer immediately.

Pupils of age six acquired more competence by being able to differentiate between LOGO Main Screen and The Commander Window. Pupils in this age level were able to apply the rules of giving commands in LOGO Programming Language by using Forward (FD) command in LOGO and Clean command to draw different sizes of squares. They could not go further because, in public primary schools, most of the pupils of age 5 and some of age 6 were not familiar with the computer and they could not manipulate the mouse and recognize the letters on the keyboard. This impeded their effective ability to carry out the commands. This could be why they could not go further in other modules.

According to Rache (2004), this type of research acknowledges that children in different locations or from different family backgrounds will have different experiences of childhood, and that when it comes to ICT, not all children will be starting from the same point. It acknowledges that children will have different levels of interest, confidence, and prior knowledge and skills when it comes to ICT use. Vaidya and McKeeby (1985) note that the child first becomes acquainted with computers and the concepts of programming through the analogy of drawing, an activity that most children enjoy and find to be engaging. Because young children can produce spectacular pictures (graphics) with LOGO, their motivation to learn and play with the language is usually very high, and not entirely dependent on their ability to read or write. The implication of this result is that the pre-primary pupils should be taught comprehensively the rudiments of numbers, letters and shapes in such a way as to transfer it to other learning environments. They should be introduced to the basics of Computer Studies by being taught parts of the computer, keyboard and mouse manipulations before they enter primary school so as to aid their manipulation of computers, which is a stepping stone for learning programming language.

It seems obvious that when a key is pressed on the keyboard the corresponding letter, number or symbol appears on the screen. However, when a child is told to press a key and then looks at the screen to see the corresponding letter or number, the child is allowed a unique way to remember the shapes that are letters and numbers. As reported by Zevenbergen (2007), the keyboard, sizing and print tools enable young children to create their names and other words, as well as numerical symbols, in a variety of ways not previously possible. All this knowledge will enhance their acquisition of competence in LOGO Programming Language.

Pupils of ages 7 and 8 moved further in LOGO by saving their pictures and turning the turtle to different directions using Right (RT) command in LOGO. They were also able to print their pictures. Pupils of age 8 years were able to open their saved pictures and used Penerase command to erase unwanted lines during drawing. This is because most of them could recognize letters and numbers to be able to carry out the commands with ease; they were not limited to icons and pictures on the screen for understanding. This shows that more opportunities for independent use of LOGO software become available with increasing language and literacy skills. This agrees with the findings of Harrison *et al*. (2002) that the use of ICT improves attainment levels of school children in English, in Science and in Design and Technology between ages 7 and 16, particularly in primary schools

No pupil of any age level was able to acquire competence to use Penpaint command to continue his/her drawings, use repeat command to draw different shapes and turn the turtle to the left side at different steps using left (LT) command. They were also unable to use the turtle to draw different types of polygons. This could be because, at that age level in pubic primary schools; pupils were not familiar with polygons. The teachers reported that, in public primary schools, Computer Studies is only introduced at age 8 years and above. They have limited access to computers and are often restricted in the types of software and purposes for which they use the computer. They used drill and practice software in which the computer is in control and leads the pupils through the lesson. Despite the above, the pupils were eager to attend the computer classes and even wanted the teaching period extended. The teachers were also willing and eager to help the pupils' in this new technological change that might help pupils' progress in school. The pupils in ages 6 to 8 mastered the basic graphics commands and acquired special skills on how to write simple programs and draw simple shapes like cycle, square and rectangle. This observation is in consonance with the findings of Hughes *et al*. (1985) as well as Papert (1980), who observe that the child could acquire competence in instructing the Turtle to move around its environment in a particular way, and in so doing will produce a drawing or pattern and thus enhance their cognitive development.

5.6 Private school pupils' competence in the modules by age

The result obtained showed that the private primary school pupils of ages 5 to 8 acquired competence in modules 1 to 12, that is opening Microsoft Windows LOGO, exiting LOGO software, LOGO Turtle Graphics, Identify LOGO Opening Screen, ability to differentiate between LOGO Main Screen and the Commander Window, executing commands to draw different sizes of circles, save their works, use forward, right and clean commands. They taught the turtle to draw a square, open their saved pictures and use Penerase to clean unwanted lines, continue the drawings by using Penpaint command. One possible explanation for this finding is that most pupils' in private primary schools came into the program with some computer experience from a variety of sources. Several researches have indicated that people with more computer experience show significant higher levels of computer confidence and more computer training is effective at raising user computer efficacy levels, which results in improved performance on computer-related tasks (Torkzadeh and Koufteros, 1994; Marakas *et al*., 1998; Rozell and Gardner III, 1999). However, competence declined in module 16 which is a repeat command. This particular module, unlike the previous modules, has three parts, which are made up of the command REPEAT, a number which specifies how many times the given command is to be repeated, and the command itself. So, it is a little bit different from what the pupils were exposed to in the previous modules.

Furthermore, pupils in ages 6, 7 and 8 acquired competence on module 17 that is turning the turtle to the left side at different steps using Left/LT command, pupils of age 8 acquired competences in module 18 and 19, using the turtle to draw different types of polygon, and changing the pen to different colours to make designs. No pupil of any age level was able to acquire competence in module 20, which is on letter graphics in LOGO. This is, perhaps, because it requires a higher level of thinking skill. In contrast to the public schools, private primary school pupils have more than a beginners' skill level because of their computer literacy experience at home and in school. This made them more confident about this new resource. They attended classes with previous knowledge of graphics because of previous exposure to some application programs. There was ample evidence of creativity, independent thinking and a real effort to take charge of their own learning at all the age levels. It was found that the pupils could plan, explore, debug and build, although most of them worked in a trial and error fashion. They would begin with one idea and proceed with other ideas. This support Pea and Kurland (1984), who opined that skill in LOGO programming is related to improved planning skills. Also, they expressed enjoyment when exploring LOGO, making patterns, working with large numbers, and trying different designs. There was no evidence of deficiency in thinking skills. They explored using more than one variable. There was ample evidence of creativity, independent thinking, and a real effort to take charge of their own learning.

The study has revealed that LOGO programming can be introduced to age 6 years old from preoperational stage of Piaget four stages of cognitive development. This stage which is between the ages of 2 to 7 years according to Piaget during this stage has the following characteristics - intelligence is increasingly demonstrated through the use of symbols and memory and imagination which are developed as language use matures. The child takes in information and then changes it in his mind to fit his ideas, using neutral words, body outlines and equipment a child can touch which gives him an active role in learning (Huitt and Hummel, 2003). LOGO Programming fits well into this stage because pupils use the software in such self-directed ways, can experience mastery and competence at many different levels and can become more adept to programming. At this age level (6 years), pupils were able to acquire competence in modules 1 – 7 in LOGO package conveniently without any assistance from the teachers. The modules include opening and exiting the Microsoft Windows Software, identifying the turtle, LOGO Main Screen and The Commander Window and commanding the turtle to draw different sizes of circles.

At age 7, the pupils will use the previous knowledge to continue from module 8 to module 12. The modules include the following:- the pupils saving their work, mastering the LOGO primitives/commands like forward and clean commands, turning primitives/commands in LOGO, teaching the turtle to draw a square and printing their pictures.

At age 8, the pupils will continue from module 13 to module 15. The modules include opening saved pictures, using the primitive penerase to clean unwanted lines and using Penpaint to continue their drawings. By the time the pupils will be 9 years old, they will be more mature to be able to continue with the remaining modules that is, teaching the turtle to use repeat command, using left/lt primitive, commanding the turtle to draw different types of polygon, changing the pen colour and further with letter graphics in LOGO. An explanation for this finding may relate to the content of the researched module which is difficult for young students to engage with (Hans *et al*., 2007). According to Tuovinen and Hill (1992), LOGO is an effective environment that facilitates children's development of cognitive and problem-solving strategies, increases the sophistication of children's thinking about geometric concepts (Clements, 1990), and facilitates children's learning about mathematics (Clements and Meredity, 1993).

In the public and private schools, the pupils' expressed excitement when exploring LOGO environment and making different patterns with LOGO and they enjoyed working in teams. Also, most of them showed confidence and pride when they explained how they managed to get their work done. Pupils were eager to show their programming projects and the teachers were very impressed with their pupils' work. Teachers reported that the pupils' wished to learn more about programming in the future and talked about lack of time to write more programs. This study further revealed that, in both public and private schools, as the ages of the pupils increase, their level of competence in LOGO Programming Language improved. This is in accordance with Shields and Behrman (2000), who cited the results of national survey data which revealed that children from 2 to 17 years of age spend approximately "...34 minutes per day, on average, using computers at home, with use increasing with age. Indeed, the pupils in all the schools want to use the computer beyond the time allowed.

5.7 Pupils' competence in LOGO Programming Language before and after exposure to the LOGO Instructional Package

Our findings showed that there was significant difference between pupils' competence in LOGO before and after exposure to the LOGO instructional package. This finding agree with Papert (1998) that computers have an impact on children. When the computer provides concrete experiences, children have free access and control the learning experience, children and teachers learn together, teachers encourage peer tutoring, and teachers use computers to teach powerful ideas.

It was also found that there is no significant mean difference in male and female on pupils' competence in LOGO Programming Language. This is in accordance with the findings of CERI (2010) that both boys and girls seem to be involved and interested in using ICT different tools, both at school and elsewhere. This result buttresses Kay and Knaack's

(2008) finding, that there were no gender differences in terms of quality, engagement, or performance in learning. It may be due to the fact that girls were just as interested as boys because LOGO programming is a child-friendly computer language which totally absorbed the interest of both male and female pupils. According to Papert (1980), children love the turtle and engage in LOGO activities with a high level of motivation and a deep level of concentration. This finding corroborates the view earlier findings of Huppert (2002), that simulation software used in science learning provides higher achievements of students than those not using the simulation, with girls achieving equally with boys. The finding is also in line with the finding of Underwood and Underwood (1990) and Adebanjo (2004) that girls perform as well as boys when they engage with computer-based learning tasks and programming activities. Hyde and Mertz (2009) also showed that, in the United States of America, the girls now perform as well as boys in all grades. They add that the gender gap has been closing over time at all levels and will continue to narrow in the future. Conversely, Yelland (1994) and Schaumburg (2001), note that differences emerged when children engaged in programming, a post-test-only assessment indicated that boys performed better than girls. However, assessment of the children's interactions revealed that the boys took greater risks and thereby reached the goal. In comparison, girls were more keen on accuracy; they meticulously planned and reflected on every step (Yelland, 1994). Also, Hoxmeir *et al.* (2000) argue that gender difference that existed between male and female participants before the commencement of a computer training programme diminished considerably at the end of training and exposure to computer. The implication for teaching is the need for consistent, long-term observation. In addition, Nelson and Cooper (1997) and Mumtaz (2001) assert that male students tend to have more confidence in their computer abilities than their female peers, and this pattern is quite consistent from the elementary school. Also, research reveals that males use computers more often (Nelson and Cooper, 1997; Vekiri and Chronaki, 2008), it also makes it clear, as this study also bears out, that this does not necessarily promise higher performance

A number of explanations have been offered to explain gender differences, one of which proposed that they are linked to the issue of individual versus collaborative modes of working. Hoyles, Sutherland, and Healy (1991) found that when computers are used individually, girls tend to find the experience isolating, thus reducing their performance.

However, when the computer is associated with collaborative model for working, as in the case of this study, girls are typically as eager as boys in their response and performance.

The mean difference in competence of pupils with high and low computer literacy in LOGO Programming Language is significant. It was observed that pupils' with high level of computer literacy performed better than their counterparts with low level of computer literacy. This implies that certain level of computer literacy is still needed for acquiring better competence in LOGO Programming Language. The finding corroborates that of Anderson (1996), that prior computer experience using computer is one of the most important factors determining student attitudes toward computers. Therefore, Computer Studies need to be introduced early in primary schools for knowledge and ability to use computers efficiently to acquire better competence in LOGO Programming Language.

The result obtained in this study indicated that there is significant mean difference of school type on pupils' competence in LOGO Programming Language. This supports Ajayi (1999), which revealed that school type makes a difference in students' academic performance. The study found that public primary school pupils' performance in the 20 modules is lower than the performance of pupils' in the private primary schools. This may be due to the previous computer literacy experience of private primary school pupils. Many of the pupils in private schools had interacted with the computer before. Some of them have parents that are usually working with computers and they have been exposed to the computer before the age of 5. Several researchers reported that prior exposure to computers had a significant effect on performance (Oman, 1986; Anyanwu, 1989; Taylor and Mounfield, 1991) and subsequent computer related tasks (Anderson, 1996; Marakas *et al*., 1998; Rozell and Gardner III, 1999). Conversely, pupils in public school do not have this exposure, as most of them are interact with the computer for the first time in school at the age of 8.

Judge *et al*. (2004) have reported that it is increasingly important for early childhood educators to introduce and use computers in their settings, particularly for those children who do not have access to it in the home like most pupils in public schools. Providing learning opportunities at preschool means that these children are better prepared for their school experiences. Offering access to computers in the early childhood setting helps to reduce the digital divide that occurs at school when those who have had access in the home are better prepared for school activities. This notwithstanding, there is still a significant difference in pupils' competence in LOGO Programming Language after exposure to the LOGO Instructional Package in the public primary school.

In both school types, the computer classroom was a rich learning experience for following reasons: (a) the children worked in pairs and were expected to communicate with each other, (b) the traditional teacher's role had changed primarily from teacher to facilitator. The role of the teacher is a most significant variable in the LOGO classroom. The teacher no longer fills the central role of "provider of knowledge"; then the children must take an active role in learning. In such an environment, the child makes many decisions. He/she can determine success or failure. If a programme fails, he/she can decide whether to fix it or move on. If children are making decisions about what they have learned and what they will do, it seems less likely that the teacher can occupy determining status. The child's relationship with his/her work is a direct one. There is less reason for competition and more cause for sharing and cooperating as pupils work together and borrow ideas from one another. The LOGO environment also demands a different role for teachers and a new relationship between peers in the classroom.

The children used in this study learned that computers could help them and that they could master the computer. They understood that they had amassed a number of skills that would assist them whenever they encountered a computer. Computer literacy is best expressed by having an "I can do it" attitude towards computers. LOGO expertise helps provide that attitude.

5.8 CONCLUSION

The purpose of this study was to develop and utilize an instructional package for acquiring competence in LOGO Programming Language at private and public primary schools. The results showed that there was a significant difference in pupils' competence in LOGO Programming Language after exposing them to LOGO Instructional Package irrespective of the type of school. However, pupils in private schools showed higher competence than those in public schools. This is adduced to earlier computer exposure of the former. The study also showed that computer competency increases with age irrespective of school type (private and public).

LOGO programming was applauded in this study. The teachers expressed interest in using the LOGO software in future owing to their perception of its utility and educational benefits. Because of this, LOGO Programming Language should be included in Computer

Studies curriculum for primary school pupils' and should be introduced to pupils as from age six. As pupils are able to read and write on their own, they are not limited to icons and pictures on the screen for understanding. More opportunities for independent use become available with increasing language and literacy skills.

The results also showed that there is no significant mean difference of gender on pupils' competence in LOGO Programming Language. Furthermore, despite the challenges of finding enough time, funding and support to pursue the implementation of developmentally appropriate LOGO programming with public and private school pupils, it is a worthwhile, exciting, and developmentally appropriate endeavour that will undoubtedly continue into and beyond the foreseeable future. Experience with LOGO Programming to date suggests that given age-appropriate technologies, curriculum and pedagogies, young children can actively engage in computer programming activities in ways that are consistent with developmentally appropriate practice.

5.9 Recommendations

1. Training

   Governments at the three tier of governance should endeavour to fulfill the policy that has been enacted to train teachers in the area of computer literacy. This study revealed that only a few teachers in a relatively small number of schools had been trained to maximize technology use in schools. Training opportunities enable teachers to build skills and confidence and learn strategies to integrate computers into their curriculum. Teachers can also participate in workshops, seminars and local and international conferences that integrate the developmental theory and research regarding computer use with hand-on experiences. To attain and maintain support of any new program, good communication is necessary. Communication could include workshops, regular collaborative meetings, face-to-face conversations, school visits and presentations/demonstrations for policymakers and school boards.

2. School Programme

   The Federal Government of Nigeria has made a policy statement to incorporate computer education into basic education. This is aptly justified by the introduction of computer education in primary schools. However, the present one period per week for computer activities should be increased to at least 3 periods per week and LOGO Programming Language should be included in the curriculum for primary schools. School leaders should also learn by visiting other schools, talking to other school leaders, going to conferences to learn more about how technology can be used to achieve their goals.

3. Facilities

Government should increase the funding of education to enable schools to acquire facilities that will encourage computer training and awareness. The present efforts of the Federal Government of Nigeria to resuscitate the power sector to ensure stable electricity supply are highly commendable. In the interim where it is difficult to get stable electricity supply, generators should be supplied to all schools to ensure the availability of electricity during the period of computer activities. It is equally essential to employ computer technicians for the maintenance of computers and accessories in schools. Also, as pupils are admitted to the primary level, it is important that they have access to a computer centre with a library of developmentally appropriate software because pupils need opportunity to make choices about some of their computer experiences.

5.10 Contributions to knowledge

1. In this study, an instructional package for learning LOGO Programming Language was developed and introduced to Nigerian pupils of ages 5 to 8 years. These age groups were able to write programs on sequences of instructions that allow the turtle to move and respond to their environment to make different shapes and designs as pupils in other parts of the world. Although in the National Policy on Computer Education, LOGO Programming is expected to be taught at the Junior Secondary School level this has not been introduced up till now. This study shows that pupils as young as five years old can be good at programming if they have an early exposure.
2. The present study had added to the knowledge about young children's performance in a LOGO-programming environment. This provides information for researchers and teachers about aspects of learning that may be salient to their learning opportunities for young children with computers. Indeed, it has been realized that of all the applications of computers to education, perhaps none has generated as much

excitement, and as many claims to potential benefits, as computer programming, especially LOGO Programming.

3. The findings serve as feedback to curriculum planners on their recommendations on the contents of Computer Studies curriculum.

5.11 Suggestions for further studies

Similar studies can be carried out in other states of the country in order to widen the scope and generalizations of the findings. Other variables, like access and computer self-efficacy knowledge to computer, not covered in this study can be considered by subsequent researchers.

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APPENDIX II

UNIVERSITY OF IBADAN

DEPARTMENT OF TEACHER EDUCATION

TEACHERS PERCEPTION SCALE OF LOGO INSTRUCTIONAL PACKAG (TPLIP)

Dear Respondent,

This questionnaire is aimed at eliciting information on the perception of teachers on the use of the LOGO Instructional Package (LIP) in Primary schools. You are requested to respond to the items and return it to the researcher immediately after filling. Thanks you. substantiate

PART ONE

Section A: Biographic Data

1.**Name of School**:……………………………………………………………

2. **Age(yrs)**: (i) under 25 [ ] (ii) 25-30 [ ] (iii) 31-40 [ ] (iv) 41-50 [ ] (v) Above 51[ ]

3. **Gender**: Male [ ] Female [ ]

4. Which of the following best describes your qualification?

a. ND/NCE/HND
b. B.Sc/B.Ed/B.A
c. M.Ed/M.Sc/M.A
d. Others (specify)

Section B:

Please use the following mode of responses and place a tick √ in the appropriate boxes

Your responses will be treated as confidential.

KEY

SA - Strongly Agreed A - Agree

D – Disagreed SD – Strongly disagreed

S/N	STATEMENT	SA	A	D	SD
1	This package is easy to use.				
2	I am in control of the contents of the menus and toolbars				
3	I am able to learn how to use all that is offered in this				

	package.				
4	Navigating through the menus is easy to do.				
5	This package is tasking.				
6	The contents of the menus match my needs.				
7	Getting started with this version of the software is easy.				
8	Finding the options that I want in the menus is easy.				
9	It is easy to make the software do exactly what I want.				
10	Discovering new features is easy.				
11	I get my programming tasks done quickly with this package.				
12	Hardware problems often disrupt the lesson				
13	Using Logo instructional package to teach is expensive				
14	Logo software makes lessons more fun.				
15	Using Logo instructional package in my teaching is not enjoyable.				
16	Logo instructional package makes the lesson more difficult.				
17	Using the software raises pupil's morale.				

APPENDIX III
UNIVERSITY OF IBADAN
DEPARTMENT OF TEACHER EDUCATION
APPROPRIATENESS AND UTILIZATION SCALE FOR DEVELOPED LOGO INSTRUCTIONAL PACKAGE (AUSDLIP)

Dear Respondent,

This questionnaire is to evaluate LOGO instructional package in terms of age relevance, presentation of illustrations and sequence of content for primary school pupils. You are requested to respond to the items and return it to the researcher immediately after filling. Thanks you.

To be completed by the teachers.

S/N	ITEMS	YES	NO
1	Is the package consistent with the way children learn and develop?		
2	The content is accurate and reliable		
3	Does the package promote active learning?		
4	The language is appropriate for the target group?		
5	There are some levels of difficulty and challenges		
6	The levels of difficulty and challenges add values to learning and teaching.		
7	Does it excite and promote you language acquisition		
8	Can it be applied to real-life situation		
9	The information is well structured to support teaching and learning.		
10	The vocabularies, phrasing and sentence length are appropriate		
11	The examples and graphics are appropriate for the age group		
12	Progression of presentation is logical and well defined		
13	The package leads to the understanding of the nature of pupils' needs.		
14	The package added value or quality to the standard curriculum		
15	The package is initiating review of the curriculum		

APPENDIX IV

UNIVERSITY OF IBADAN

DEPARTMENT OF TEACHER EDUCATION

CHALLENGES OF LOGO INSTRUCTIONAL PACKAGE USAGE (CLPLPU)

Dear Respondent,

This questionnaire is aimed at eliciting information on challenges Nigerian teachers will face in using LOGO Programming Language in the classroom. You are requested to respond to the items and return it to the researcher immediately after filling. Thanks you.

To be completed by the teachers.

Kindly indicates ( ) factors that can serve as challenges to the use of LPLPC. (Indicate as many as applicable)

1. Insufficient number of computers for teachers' use. ( )
2. Insufficient number of computers for pupils' use. ( )
3. Insufficient funds available for purchase of equipment. ( )
4. Teachers lack of interest/willingness to learn LPLP. ( )
5. Teachers lack of expertise. ( )
6. Lack of maintenance and technical staff. ( )
7. It is difficult to integrate LPLP into classroom instruction practices. ( )
8. No enough staff to supervise pupils' while using LPLP. ( )
9. Problems in scheduling enough LPLP time different classes. ( )
10. No time in teachers' schedule to explore opportunities for using the LPLP.( )

Adapted from School and Program Questionnaire, International Generic Version OECD 2004 (http://www.oecd.org/dataoecd/27/35/2756981.pdf)

APPENDIX V

COMPUTER LITERACY QUESTIONNAIRE

The questionnaire is divided into two parts. In part A, you are asked to provide some basic background information about yourself and your experience with computers, if any. Part B aims to elicit more detailed information by asking you to indicate the extent to which you agree or disagree with a number of statements provided.

PART A

1. Name …………………………………………………………………………………..
2. Age ……………………………………………………………………………………
3. Sex: Male ……………….. Female ……………………
4. Do you have any experience with the computer? Yes…… No …………
5. If answer to question 4 is yes, then how long have you been using computer?
    a. I have not use computer before
    b. Less than a month
    c. Three month ago
    d. Six month age
    e. Over a year
6. Who taught you how to use computer?
    a. My teacher
    b. My parents
    c. My sisters
    d. My brothers
    e. My friends
7. How many times do you use computer in a week?
    a I don't use it at all
    b. Once a week
    c. Twice a week
    d. Three times a week
    e. Everyday
    f. Others (specify)

PART B

Below you will find a number of statements, please indicate the strength of your agreement/disagreement with the statements using Yes/No Scale shown below:

		Yes	No

1	Do you have access to the computer in school		
2	Do you have computer at home		
3	Are you free to use computer at home?		
4	Computer is a machine		
5	Can you identify the parts of the computer		
6	Can you start the computer		
7	Can you shut down the computer		
8	Can you use mouse		
9	Monitor looks like TV shows letters, numbers and pictures		
10	CPU is the brain of the computer		
11	Computers can help you to learn different subjects		
12	Computers can help you to write words, alphabets and letters		
13	Computers can help you to draw many kinds of objects and shapes		
14	Computers can also help you to play various kinds of educational and entertainment games		
15	Printer is used for printing the text and pictures which we see on the m Of computer		
16	Alphabets keys are used to type words and sentences		
17	You can color on a computer		
18	Keyboard has keys you can press		
19	You can use tool bars		
20	Computer can store a lot of information		

APPENDIX VI

UNIVERSITY OF IBADAN

DEPARTMENT OF TEACHER EDUCATION

LOGO ACHIEVEMENT TEST (LAT)

PRETEST AND POSTTEST

INSTRUCTION: Answer ALL questions

Name:

Date of Birth:

Name of School:

Male ( ) Female ( )

SECTION A

Tick ( ) the correct answer

1. Which command button will you press after the command has been entered in the Input box

   (a) Execute ( ) (b) Reset ( )

2. The mouse pointer changes its shape to that of capital I when it is in

   (a) Command recall box only ( ) (b) Input box only ( )

3. One of the ways in which you can exit Logo is by typing

   (a) BYE ( ) (b) CLOSE ( )

4. Turtle is a

   (a) Circle ( ) (b) Triangle ( )

5. Turtle has to move 20 steps in the forward direction. The command you will type is

   (a) FD 20 ( ) (b) MD 20 ( )

(6) To give a command to the turtle you type in the

   (a) Input box ( ) (b) Main Screen ( )

7 The correct way of giving a forward command and operating it is

   (a) FD(space)(No. of steps)ENTER (b) FD(NO. of Steps) ENTER

8. If the turtle is given a wrong command, Logo will give an error message in the

(a) Output box ( ) (b) On the Screen ( )

9. When we start Logo, the turtle is at its

(a) Lying down ( ) (d) Home position ( )

10. To erase all the lines from drawing area you give the command

(a) CS ( ) (b) ERASE ( )

11. To bring the turtle to its HOME position, you give the command

(a) CLEAN ( ) (b) HOME ( )

12. HT command helps in seeing the finished drawings

(a) Without the turtle ( ) (b) Turtle in the centre ( )

13. LOGO means

(a) Language of Graphic Orientation (b) Learning of Graphics Orientation

14. The MSWLogo Screen is divided into ____________ sections

(a) Three (b) Two

15. Logo Commands are called

(a) Forward (b) Primitives

16. One can see the hidden turtle by using ________________ command

(a) ST (b) MT

17. The HOME position of turtle is like

(a) △ (b) ▽

18. Once the turtle has turned, it will take the next turn from

(a) Its current position ( ) (b) HOME Position

19. Giving command RT 90, the turn would be like

(a)  (b) 

20. Total number of steps in which a turtle can turn is ___________

(a) 360^o (b) 260^o

SECTION B

DRAW THE FOLLOWING USING LOGO PROGRAMMING SOFTWARE

A. A square

B. A Rectangle

C. A triangle

D. A Flag

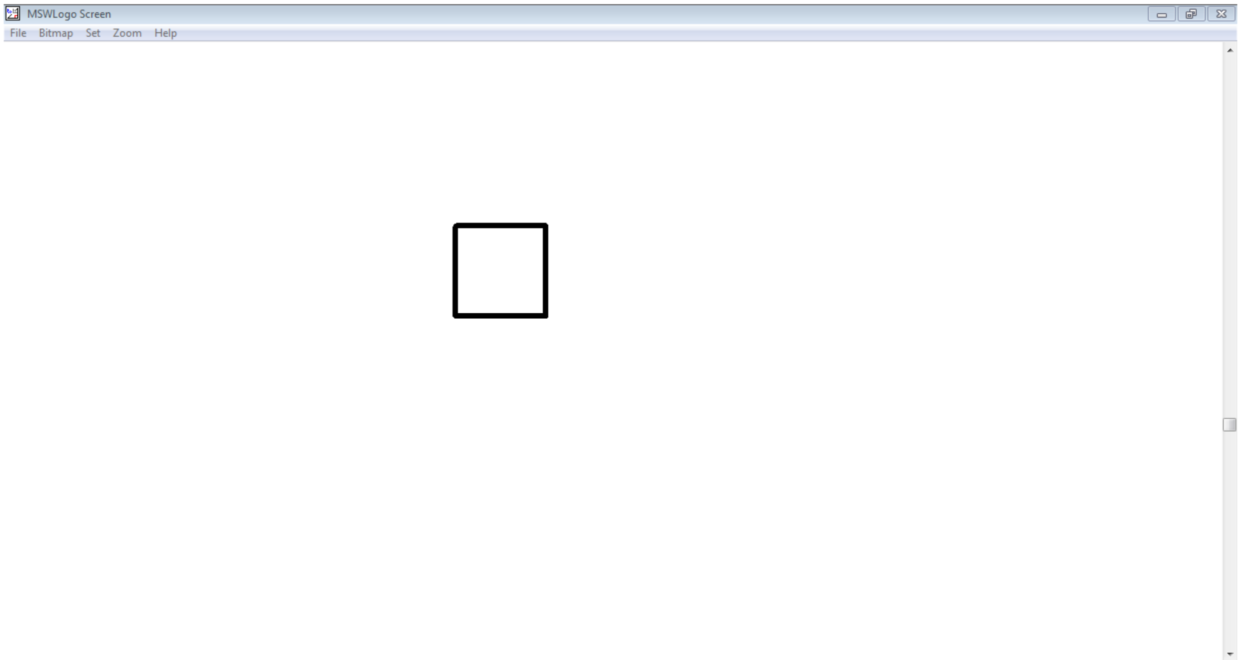
E. A Pentagon

SOLUTION TO LOGO ACHIEVEMENT TEST

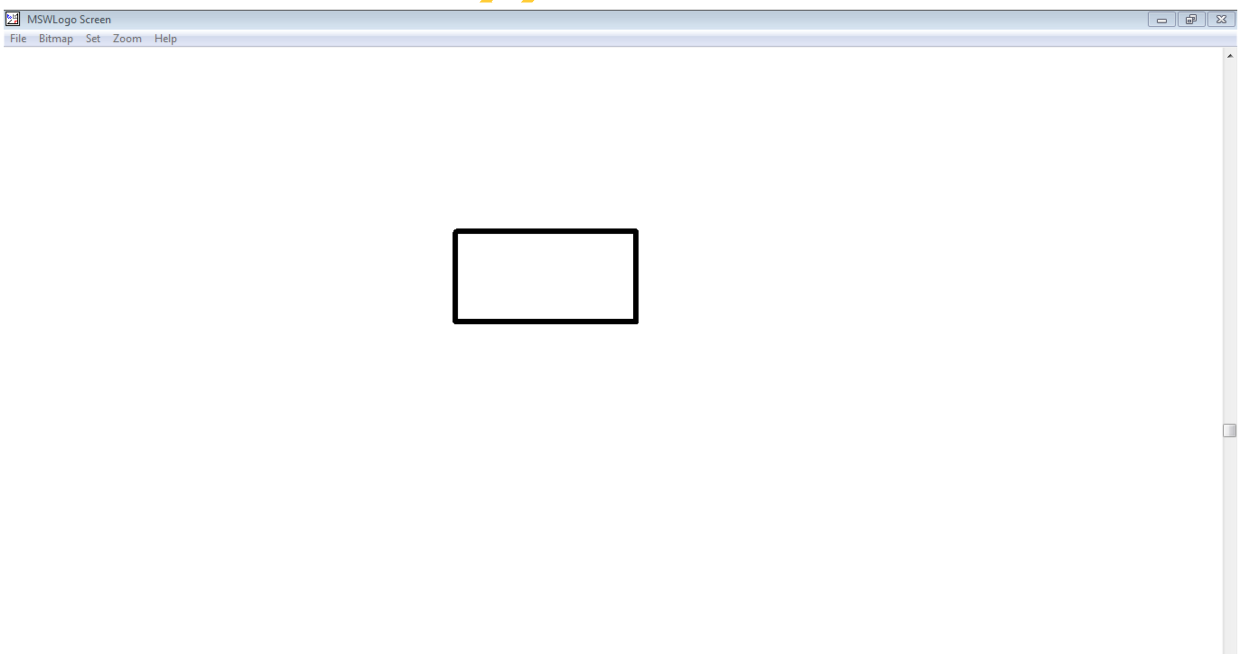
QUESTION NO	ANSWER
1	A

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

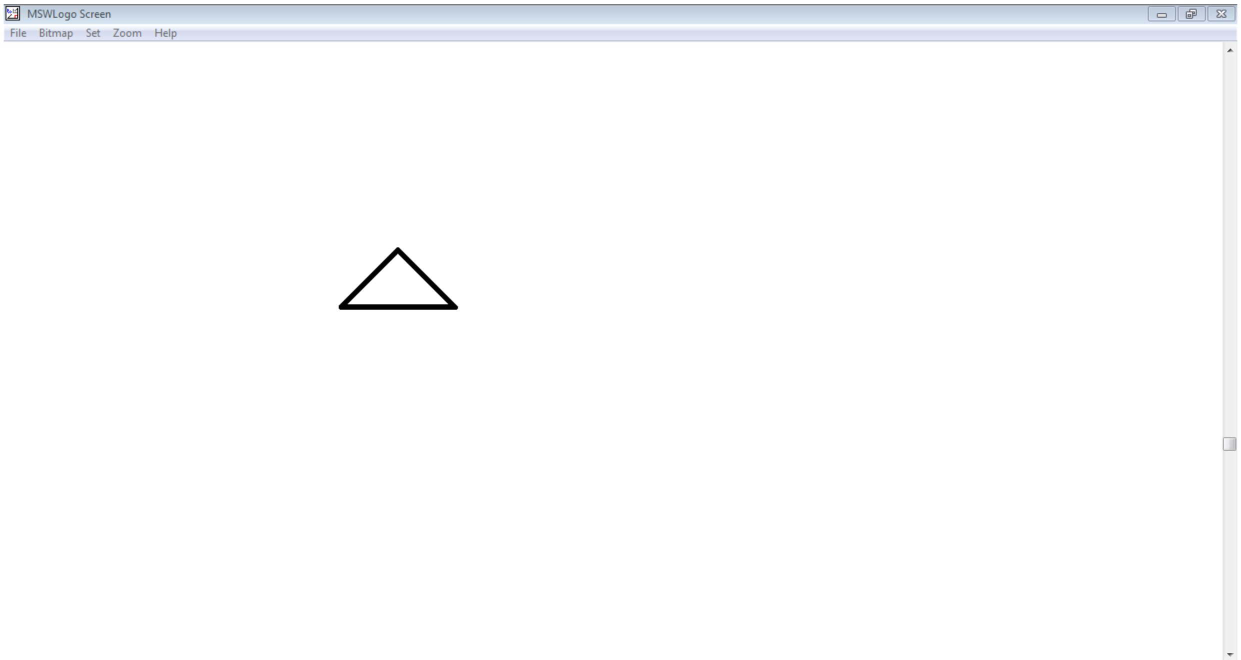
A SQUARE



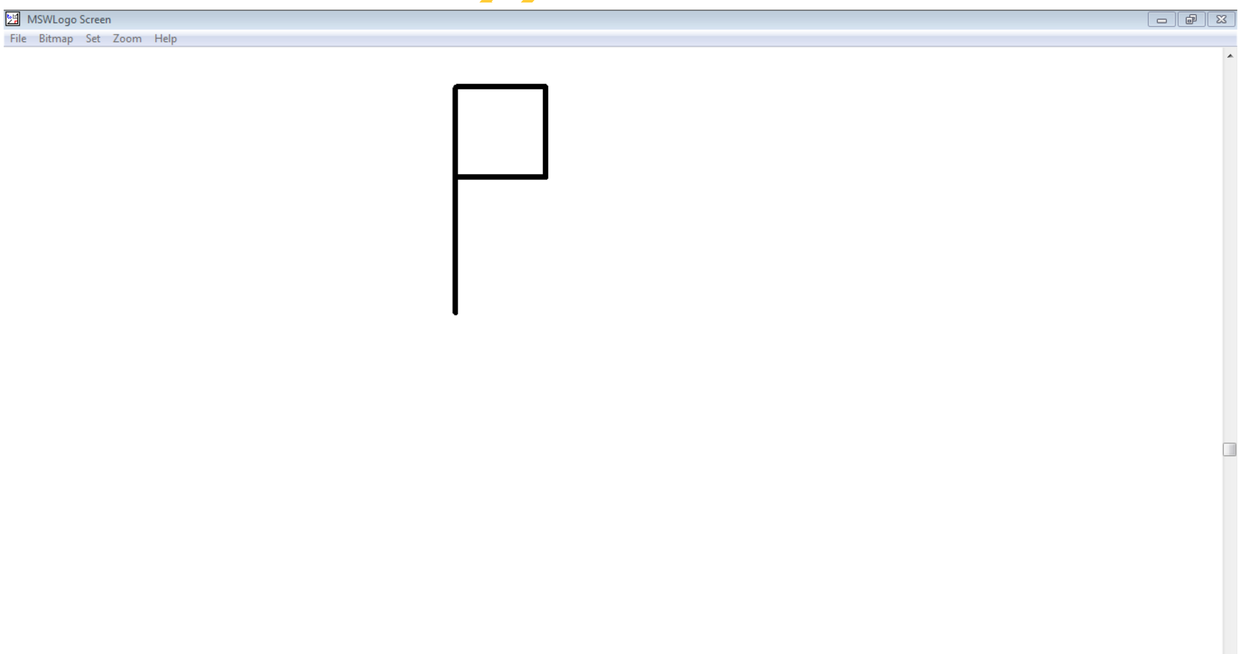
A RECTANGLE



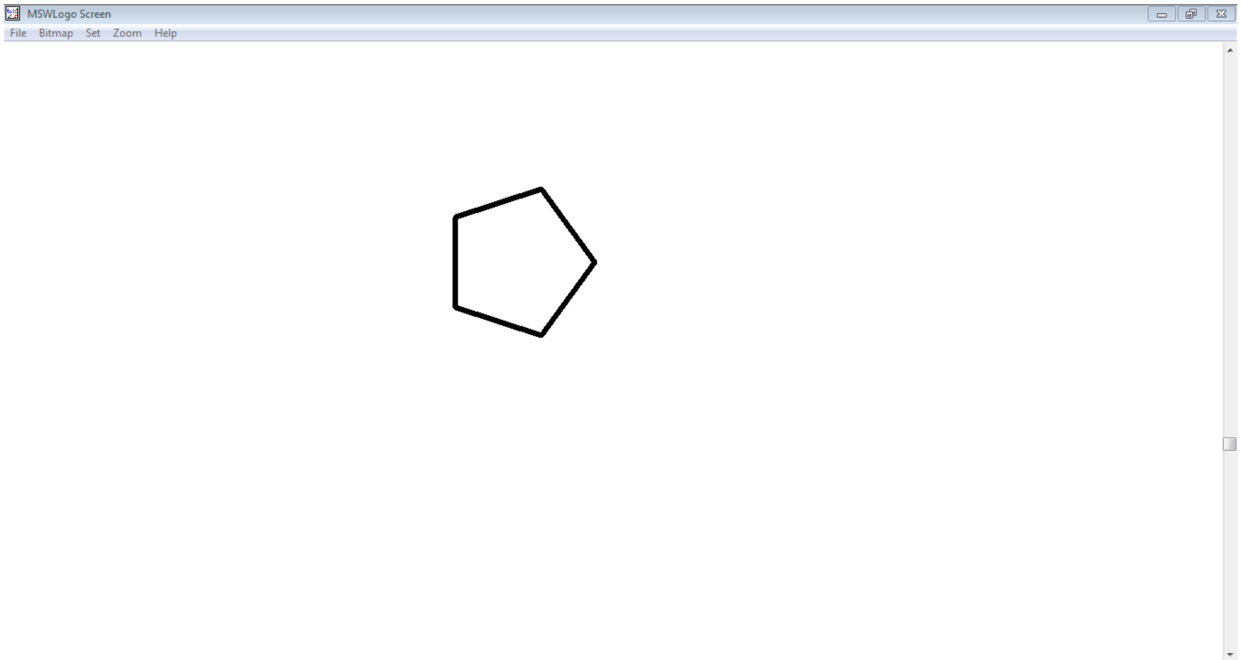
A TRIANGLE



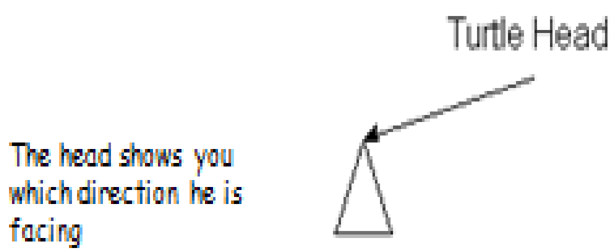
A FLAG

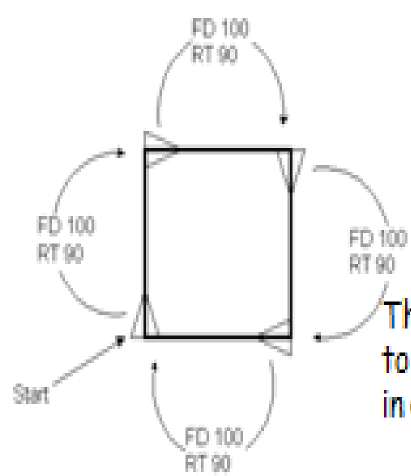


A PENTAGON

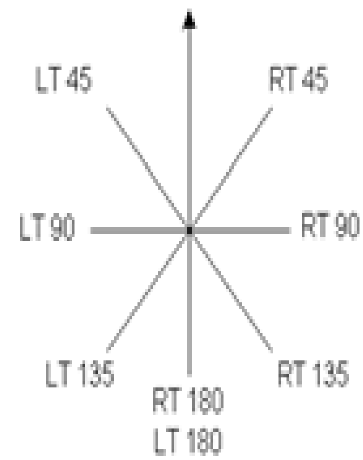

MSWLogo Screen
File Bitmap Set Zoom Help

Turtle Graphics

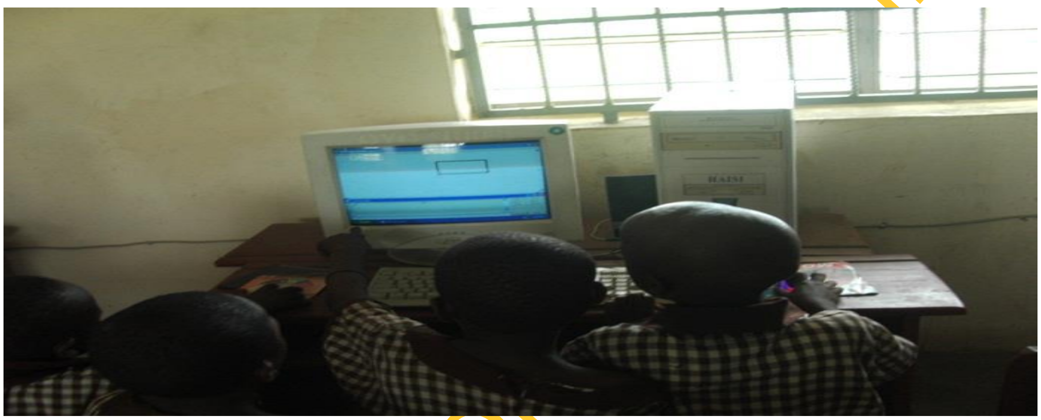


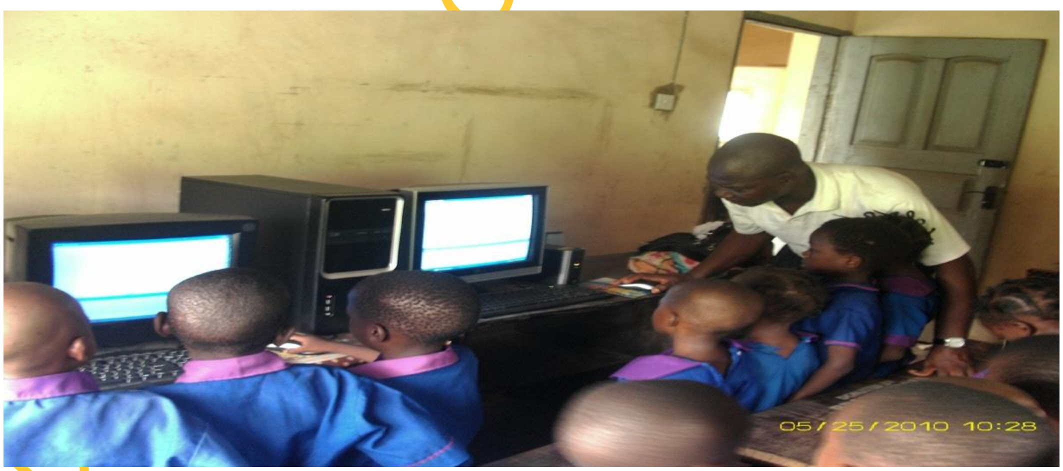


This pictures show how to make the turtle turn in different directions.



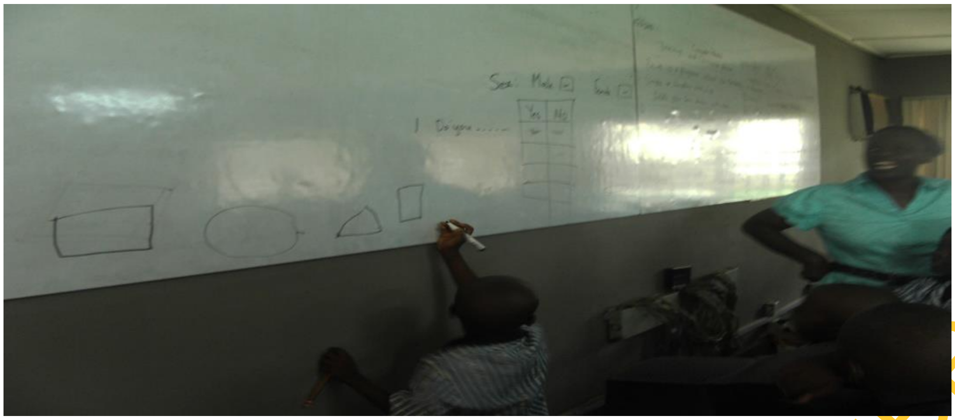
Public primary school pupils before exposure to the LOGO Instructional Package



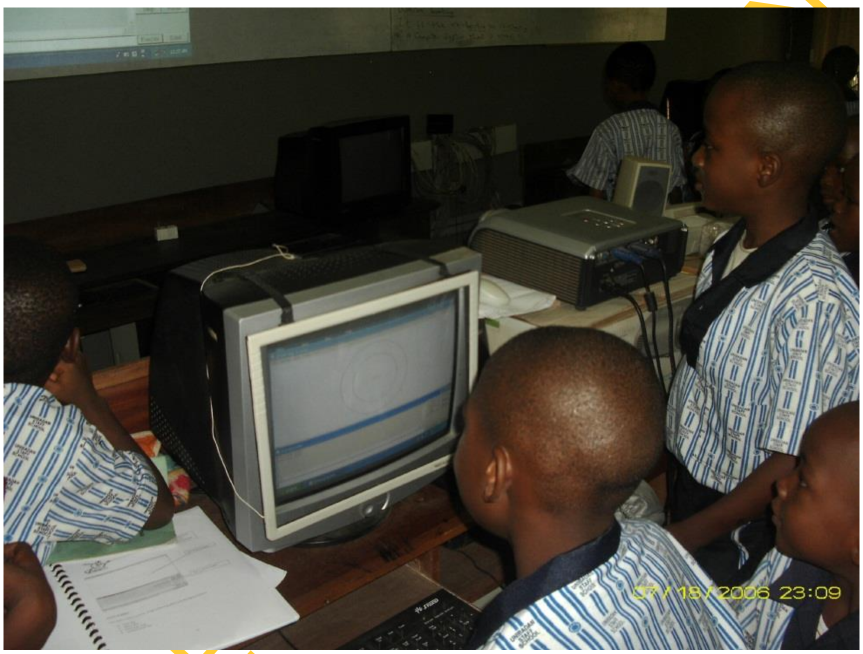


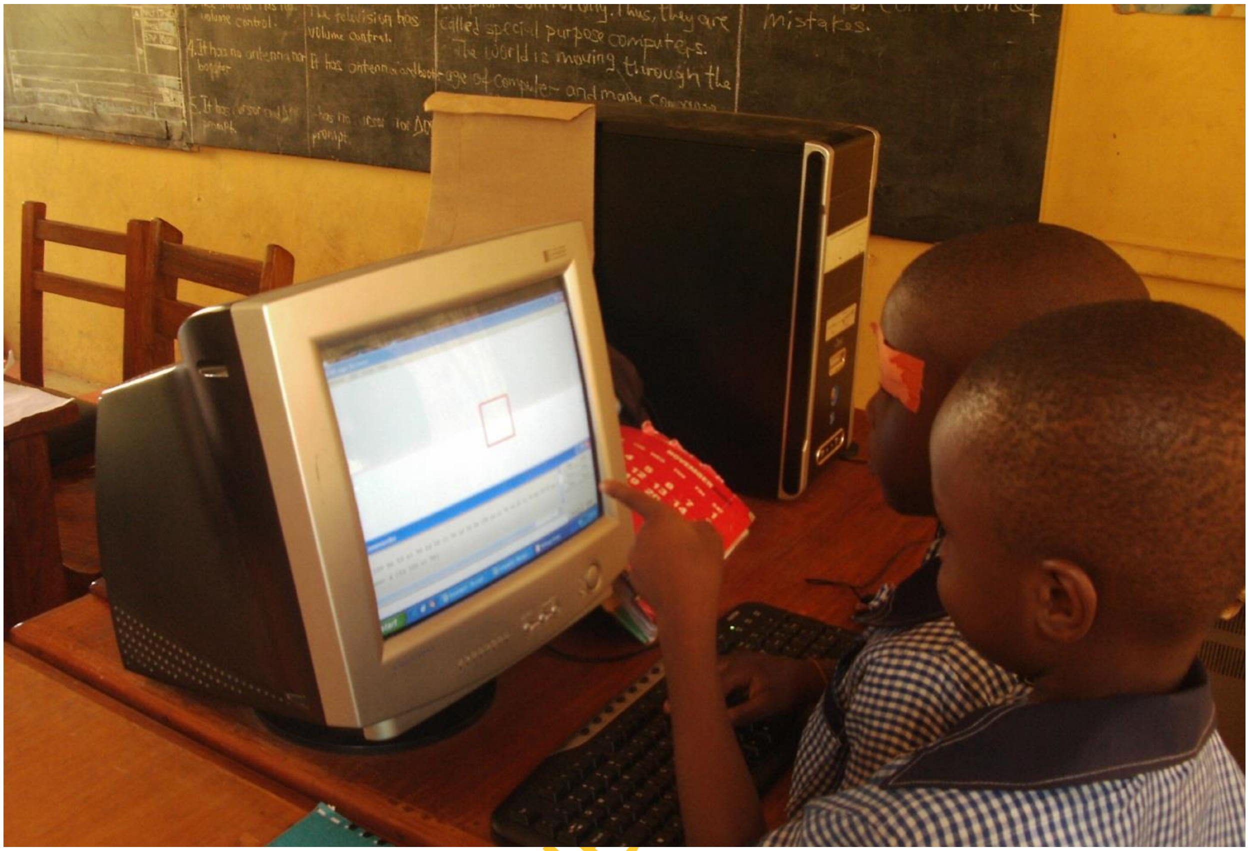
Public primary school pupils after exposure to the LOGO Instructional Package

Private primary school pupils before exposure to the LOGO Instructional Package



Private primary school pupils after exposure to the LOGO Instructional Package




called special purpose computers.
The world is moving through the
Mistakes.


turtle
MSWLogo Screen
Drawing Area

Pupils showing excitement after completing a task

A teacher using his initiative

Working with Children can be interesting

Thank you

34

DEVELOPMENT OF LOGO PROGRAMMING LANGUAGE PACKAGE FOR PRIMARY SCHOOL PUPILS (LPLP)

GENERAL AIMS:

- To enable pupils acquire basic skills in Logo Programming Language.
- To enable pupils acquire higher order thinking skills and creativity.

MODULES	**Performance objective**	**Content**	**Activities**		**Teaching and Learning Materials**	**Evaluation**
			Teacher	Pupils'		
1 Let's get Started with Logo Program. Lang.	Pupils should be able to follow the steps to open Microsoft Windows Logo	Loading Microsoft Windows Logo	Step by Step demonstration of loading Microsoft Windows Logo	Each pupil to load Microsoft Windows Logo	Computer installed with Logo Software	Load Microsoft Windows Logo. Identify the Screen of Microsoft Windows Logo.
2 How to Exit Logo Software	Pupils should be able to load and exit Logo Soft Ware	Steps to exit Logo Software	Demonstrate the two ways of exiting Logo Software	Load and Exit Logo Software	Computer installed with Logo Software	Load and exit Microsoft Windows Logo Software
3 Getting Started with Turtle Graphics	Pupils should be able to identify the turtle and the HOME position of the turtle, HIDETURTLE and SHOWTURTLE	Introduction to Turtle Graphics	Explain the turtle home position and demonstrate how to use commands to hide the turtle and show the turtle again.	Identify the position of the turtle, hide and shown the turtle using commands.	Computer installed with Logo Software	Load MSWLogo. Identify the position of the turtle. Which command will you use to hide the turtle? Which command will you use to show the turtle? Exit MSWLogo.

4 Logo Opening Screen	Pupils should be able to identify the Logo Opening Screen.	Description of Logo Opening Screen: -The Main Screen -The Commander Window	After opening Logo screen, explain all components and how to use them.	Identify the main Screen and the commander window	Computer installed with Logo Software	Identify the following in Microsoft Windows Logo: The Main Screen Commander Window
5 Logo Opening Screen	Pupils should be able to describe the Logo Opening Screen.	Description of Logo Opening Screen: -The Main Screen -The Commander Window	After opening Logo screen, explain all components and how to use them.	Identify the main parts of the Logo Opening Screen	Computer installed with Logo Software	Identify the following in Microsoft Windows Logo: The Main Screen Commander Window Title Bar Menu Bar Drawing Area Vertical Scroll Bar
6 The Commander Window	Pupils should be able to describe the Commander Window	Description of Commander Window: Command buttons Vertical Scroll bar Horizontal Scroll bar Output/Command Recall Bar Input box	Explain and demonstrate the functions of commander window.	Identify and use the parts of the commander window	Computer installed with Logo Software	Identify the following in Commander Window:- Command buttons Vertical Scroll bar Horizontal Scroll bar Output/Command Recall Bar Input box

7 The Inp140ut Box and Teaching the turtle to draw a circle	Pupils should be able identify and use the input box appropriately. Draw different sizes of circle.	Description of the Input box and how to enter and execute commands.	Explain and demonstrate the functions of the Input box.	Select the input box with the mouse and see for themselve s what happen when the mouse pointer is in the input box. Click execute button.	Computer installed with Logo Software	What happens when the mouse pointer is in the input box?
6 How to Exit Logo Software	Pupils should be able to load and exit Logo Soft Ware	Exiting Logo Software	Demonstrate the two ways of exiting Logo Software	Load and Exit Logo Software	Computer installed with Logo Software	Load and exit Microsoft Windows Logo Software
7 Getting Started with Turtle Graphics	Pupils should be able to identify the turtle and the HOME position of the turtle, HIDETURTLE and SHOWTURTLE	Introduction to Turtle Graphics	Explain the turtle home position and demonstrate how to use commands to hide the turtle and show the turtle again. Explain and demonstrate how the pupils can draw circles	Identify the position of the turtle, hide and show the turtle using HT/ST commands Draw different sizes of	Computer installed with Logo Software	Load MSWLogo Identify the position of the turtle. Which command will you use to hide the turtle? Which command will you use to show the turtle? Draw Circle 20, 50, 100, 150 . Exit MSWLogo.

				circles		
8 Saving your pictures	Pupils should be able to save their pictures and designs.	Saving Pictures and Designs	Show the steps to be taken in saving pictures.	Save their pictures	Computer installed with Logo Software	1. Start MSWLogo 2. Can you draw the map that would use the following commands? RT 90 FD50 RT 90 FD 100 LT 90 FD 110 RT 90 FD 100 RT 90 FD 30 Once you get there, you can draw a picture. 3. Hide the turtle. 4. Save your picture. 5. Print your picture. 6. Exit MSWLogo
9. Primitives in Logo – FORWARD/FD and CLEAN commands	Pupils should be able to- Apply all the rules in giving commands to Logo Prog. Lang. to demonstrate the use of	Rules for giving commands in Logo programming Language, Use of FORWARD/FD	Explain the rules of giving commands in Logo and demonstrative the use of FD	Apply the rules in using commands in logo to enter FD	Computer installed with Logo Software	Type the following commands in the Input box and record what happens in the Logo Worksheet – FD 50, CLEAN, FD, 150, CLEAN, FD 350, CLEAN,

	FD and CLEAN commands correctly	and Clean commands	and Clean commands	command and use CLEAN command.		FD 400 CLEAN
10 Turning Primitives in Logo – Right/RT command	Pupils should be able to turn the turtle to the right with a specified number of steps	Turning Turtle to the RIGHT from home position.	Explain to the pupils that the RT commands turn the turtle to the right side and demonstrate the following directions which the turtle takes when you give the commands. RT 45  RT 60  RT 135  RT 180  RT 225  RT 270 	Observe the position of the turtle turn the turtle to the right side at different steps using RT command	Computer installed with Logo Software	Type the following in the input box one after the other and record what happens in the Logo Worksheet. FD 100, BK 100, RT 90 FD 100, HT

			RT 315 RT 360			
11 Teaching the turtle to draw a Square	Pupils should be able to draw square of different sizes using the command FD and RT.	Drawing a square with FD and RT command	Demonstrate the steps to draw a square using FD and RT commands.	Draw a square of different sizes using FD and RT commands	Computer installed with Logo Software	Draw squares with each side of 20, 50, 100, 200, 400. The number of turns has to be RT 90.
12 Printing your pictures	Pupils should be able to print their pictures.	Printing Pictures	Show the steps to be taken in printing pictures	Print pictures	Computer installed with Logo Software	Start MSWLogo Draw a picture or a design by exploring what Logo can do and have fun. Hide the turtle. Print your design. Exit MSWLogo
13 Open your pictures	Pupils should be able to open their saved pictures in MSWLogo Directory	Opening Pictures from MSWLogo Directory	Show the steps to be taking in opening pictures from MSWLogo Directory.	Opening their pictures from MSWLog o Directory	Computer installed with Logo Software	1. Start MSWLogo 2. Open your saved picture. 3. Exit MSWLogo.
14 PENERASE/PE a	Pupils should be able to erase unwanted lines during drawing using	Erasing unwanted lines during drawing using	Explain and demonstrate how the pupils can	Use PENPER ASE/PE	Computer installed with Logo	1. Start MSWLogo 2. Draw a rectangle of

	PENERASE/PE	PENERASE/PE a	use PENERASE .	to make correction s	Software	FD 60 RT 90 FD 120 RT 90 FD 60 RT 90 FD 140 Use PENERASE/PE to make necessary corrections. 3. HIDETURTLE 4. Save your rectangle. 5. Print your picture. Exit MSWLogo
15 PENPAINT	Pupils should be able to erase unwanted lines during drawing using PENERASE/PE and continue the drawing using PENPAINT	Erasing unwanted lines during drawing using PENERASE/PE and continue the drawing using PENPAINT	Explain and demonstrate how the pupils can use PENERASE and PENPAINT.	Use PENPER ASE/PE to make correction s	Computer installed with Logo Software	6. Start MSWLogo 7. Draw a rectangle of FD 60 RT 90 FD 120 RT 90 FD 60 RT 90 FD 140 Use PENERASE/PE to make necessary corrections and PENPAINT to finish the

						drawing 8. HIDETURTLE 9. Save your rectangle. 10. Print your picture. Exit MSWLogo
16 Teaching the turtle to draw a square using repeating command and using CLEARTEXT/CT command	Pupils should be able to draw a square using repeat command and clear text in the output/recall box using CLEARTEXT/CT command	Drawing different sizes of square using Repeat command. Clearing the texts in the output box with the use of CLEARTEXT/CT command	Demonstrate how to use the Repeat and CT commands in Logo. Here's what it looks like in Logo REPEAT 4 [FD 100 RT 90]	Draw some other squares using REPEAT command.	Computer installed with Logo Software	Fill in the steps. The number of turns has to be RT 90? REPEAT 4[FD ------RT 90] REPEAT 4 [FD -----RT 90]
17 Turning Primitives in Logo – LEFT/LT command	Pupils should be able to use LT command to turn the turtle.	Using LT command to turn the turtle.	Demonstrate how pupils can turn the turtle with LT command	Turn the turtle around the screen using LT command	Computer installed with Logo Software	Make a triangle and a square using FD and LT command. Hide the turtle.
18 Drawing Polygons	Pupils should be able to use the turtle to draw a flat shape with 3 or more sides.	Drawing different polygons of 100 steps using repeat command.	Guide the pupils to explore the turtle to draw polygons using repeat command.	Drawing polygons with different steps	Computer installed with Logo Software	Start MSWLogo Make a Septagon (7 equal sides) and Octagon (8 equal sides) of side 50. Hide the turtle. Clean the screen. Show the turtle. Send the turtle to the HOME position. Exit MSWLogo

19 Pen Color	The pupils should be able to change the pen color.	Changing pen color	Demonstrate the steps to take in changing pen screen color.	Change pen color and make a design	Computer installed with Logo Software	1. Start MSWLogo 2. Change the pen color 3. Draw a design. 4. Hideturtle 5. Save your design. 6. Exit MSWLogo
20 Other Graphics in Logo	Pupils should be able to use Logo software to draw alphabets and two or three letter words.	Drawing alphabets	Demonstrate drawing alphabets using all the commands.	Draw alphabets	Computer installed with Logo Software	1. Start MSWLogo 2. Draw two letter words or three letter words. 3. Hideturtle. 4. Save your work. 5. Exit MSWLogo.