Journal of Educational Research and Reviews
Vol. 2(4), pp. 53-60, July 2014
Research Paper

Language of graphics orientation (LOGO) competencies of Nigerian primary school children: Experiences from the field

Ayotola Aremu • Akinyemi Adetunmbi Laolu*

Department of Teacher Education, University of Ibadan, Ibadan, Nigeria.

*Corresponding author. E-mail: adetunmibia@yahoo.com. Tel: +2347030172104.

Accepted 8th July, 2014

Abstract. The study investigated the level of Language of Graphics Orientation (LOGO) competencies that can be acquired by pupils of various age groups in four primary schools in Ibadan North Local Government Area of Oyo State. The study used self-developed and modified version of LOGO learning package adapted from Online with Computers for primary school pupils. Three hundred and forty-nine pupils aged 5 to 8 years were selected from four primary schools. They completed twenty modules of this learning package. The study adopted one-group pretest-posttest quasi-experimental design. The LOGO Achievement Test that measure achievement in each age group had reliability coefficient of 0.70. Two hypotheses were tested at 0.05 level of significance. Data were analyzed using Analysis of Variance. The results showed mean difference in pupils' level of competence with respect to their age. Pupils of age 8 had highest mean competence score [$\bar{x}$ = 34.20 (68.4%)] followed by age 7 [$\bar{x}$ = 29.71 (59.4%)], age 6 [$\bar{x}$ = 26.96 (54%)] and age 5 [$\bar{x}$ = 20.53 (41%)]. It also showed the competencies that pupils could acquire at each age group in terms of their mastery level. The study recommends that programming could be included in computer studies curriculum for primary schools as from age six.

Keywords: Instructional programme, primary school pupils, development and utilization of LOGO, competence.

INTRODUCTION

Information and Communication Technologies (ICTs) offer exceptional opportunities for learning through explorations, self-guided instruction and a creative approach to problem-solving, ICT has become a transformational tool as it expands access to quality education and is presently having a revolutionary impact on how the world is perceived and how we live in it (Vincent 2001; World Bank, 2002; Agbatogun, 2010). Governments and educational 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 (Voogt et al., 2002; Lim et al., 2004). For instance, the school starting age across European countries ranges from 4 to 7 years (Sharp, 2002) and there appears to be growing desire to prepare children of all ages for what is seen as an increasingly complex and technological world. In the United Kingdom, ICT is seen by the government as having potential to improve the quality and standards of pupils' education in addition to supporting teachers in their everyday classroom roles (Plowman and Stephen, 2003). In some developing countries such as Nigeria, 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). A review of 219 studies on the use of technology in education consistently found that students in technology rich environments experienced positive effects on performance in all subject areas (Look, 2005). Barak (2004) further revealed that the use of ICTs in education would promote deep learning, and allow schools to respond better to the varying needs of the students.

Technological advancement in ICT has brought to light the need for computer studies in educational institutions at all levels in Nigeria.

In Nigeria, the Federal Government, recognising the importance of computer education, emphasized the need for the integration of ICT into its educational system. This dates back to the National Policy on Computer Education (FME, 1988) which emphasized the need for primary school pupils to be introduced to the basic computer skills. The objectives of the computer component of the basic education curriculum are to: acquire basic computer skills such as the use of the keyboard, mouse and operating systems; using computer to facilitate learning electronically and developing reasonable level of competence in ICT applications that will engender entrepreneurial skills (NERDC, 2007).

From the foregoing discussion, it is clear that the curriculum was designed with good intentions. 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 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. A critical look at the computer curriculum prepared by the government for basic education in Nigeria shows that programming language is not included in computer studies curriculum. This serious omission is one of the ways by which Nigerian children cannot use computers meaningfully and therefore cannot benefit from its potentials. This deficiency in the curriculum results in the fact that the creative potentials of the pupils may not be well-focused in the approach to the teaching of computer studies compared with their counterparts in the developed nations where computer programming language is incorporated into their curriculum. This is a great loss to the students in terms of their knowledge of computer studies and development of creative skills. Benefits of learning programming language include an understanding of the functioning of the computer, computer software and enhance the creative potentials of pupils. It has also been advocated as a powerful environment within which problem solving or some other general cognitive skills can be developed. Programming knowledge, even at a very basic level, makes computer seem less magical and more manageable. They are engaged in logical and sequential thinking skills that underlie mathematics in that children develop fluency with the technology such that they learn to master the technological environment and become not just consumers but creators of new technologies (Resnick, 2001; Clement and Samara, 2002).

Thus to integrate basic computer programming into the curriculum for Basic Education in Nigeria, there is need to carry out studies that will reveal if Nigerian primary school pupils can learn computer programming and to what extent each age group can go. There are different types of computer programming for children such as Alice (developed to encourage girls to write programming) kudo; RoboMind; Sratch and Language of Graphics Orientation (LOGO). Out of all the programming languages, LOGO was specifically chosen for this study because it is child friendly, easy to learn and is an educational programming environment for teaching children the basics of math, geometry, programming and even thinking. The geometrical component of LOGO is known as turtle geometry. The turtle is the cursor by which the user points and moves within LOGO. Young children quickly learn to move and turn the turtle using easily-remembered, intuitive commands. For example, typing FORWARD 100 moves the turtle forward 100 pixels. Typing RIGHT 90 turns the turtle right 90 degrees.

So, LOGO provides immediate feedback, which allows pupils 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. LOGO, according to research done by Emihovich and Miller (1988), can also acquire metacognitive skills where children reflect upon their thinking which are rarely met in the regular classroom, improved problem-solving ability and mathematics ideas, enhanced spatial orientation and ability, especially regarding shape and angle awareness. According to Clement (2002), there is substantial evidence that young children can learn LOGO and can transfer their knowledge to other areas, such as map-reading tasks and interpreting right and left rotation of objects. The integration of LOGO into the Nigerian Computer studies curriculum will thus provide active, collaborative, creative, integrative approach to learning and evaluative learning. It will also allow pupils to explore and discover rather than mere concentrating on browsing and clicking as contained in the curriculum for Nigerian Primary School computer studies.

Furthermore, influence of age has been shown to exist in technology adoption contexts. Recently, Morris et al. (2005) used Theory of Planned Behavior to examine age as a moderator of the determinants of technology use. Studies regarding the effect of age seem to indicate that age variable may influence technology use in multiple ways: directly affecting technology use, indirectly influencing technology use through perceptions, and moderating the relationships between perceptions and technology use (Yi et al., 2005-2006). Studies have revealed that 5-year-old pupils who have been exposed to computer under various circumstances score higher on logical thinking tasks than children who have not been exposed to LOGO (Delgelman et al., 1986; Emihovich and Miller, 1988). LOGO, according to Gillespie and

Beisser (2001) 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. The study was therefore conducted to find out the appropriate age at which programming can be introduced to Nigerian pupils and what LOGO competencies pupils can learn at each stage. This is with a view to provide appropriate content that will fit into each age level.

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 influence of age on pupils' competence in LOGO Programming Language.

METHODOLOGY

The study was in two phases: the first phase was development of LOGO Instructional Package (LIP) using Kerr's Model of Curriculum development, whose design is based on the following: (1) objectives (2) Knowledge (3) evaluation and (4) school learning experiences. The content for the package was adapted from Online with Computers for primary school pupils and review of literatures. The second phase dealt with using the package to determine its effectiveness. The package is divided into modules and it contains step-by-step activities for pupils in each of the modules. The activities were designed with the developmental stages of children in mind as the tasks in the modules were arranged from simplest to most challenging. After each of the module, the pupils take a test. The second phase adopted one group, pretest-posttest design in which there is no control group. 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 a selected variable- age, as follows: age at four levels [A (5+ years), B (6+ years), C (7+ years), D (8+ years)]. The Measures of Competence in LOGO was based on the competencies in skills shown in Table 1. The table presents the modules and questions that address the skills as shown.

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. Four primary schools which include Community Primary School, Ikolaba, C & S New Eden School, Mokola, Bodija International School, Bodija, and Staff School, University of Ibadan were purposively sampled for this study.

The population for this study was made up of teachers and pupils in Community Primary School, Ikolaba, C & S New Eden School, Mokola, Bodija International School, Bodija, and Staff School, University of Ibadan in Ibadan North Local Government Area of Oyo State. Four primary schools were purposively sampled for this study. In each school 25 pupils in ages 5+, 6+, 7+ and 8+ that fell within the age range for this study were randomly selected at each age level in each of the schools. Three hundred and forty-nine (349) pupils aged 5 to 8 years were selected from the four primary schools. The criteria for the purposive school sampling were:

(a) availability of computer laboratory facilities;
(b) the availability of computer teachers.

Treatment

Instructional guide on LOGO Programming Language Package (IGLPLP)

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 treatment was used for teaching the pupils. The content for the package was adapted from Online with Computers (2007) for primary school pupils and review of literatures. There were 20 modules in the instructional guide. The package contained the step-by-step activities for pupils in each of the modules.

LOGO Programming Language Achievement Test (LPLAT)

This was developed to measure pupils' level of performance in each of the modules in LOGO. The items were generated around three levels of the cognitive domain (that is, knowledge, comprehension and application). 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.

The data collection procedure for the study followed the outlined sequence of activities: Training of Teachers, Administration of Pretest, Administration of the LOGO Package, and Procedure for the Administration of the

Table 1. Various skills acquired by pupils in the application of LOGO software.

	Skills	Module	Question
Task skills	Being able to perform individual LOGOs tasks	1, 2, 3, and 4	1. When you start Logo, the turtle is at its……. 2. Which command button will you press after the command has been entered in the Input box….. 3. The mouse pointer changes its shape to that of capital I when it is in….. 4. One of the ways in which you can exit Logo is by typing… 5. Logo Commands are called….
Environment skills	Being able to manage a number of different tasks within the LOGO package	5 and 6	1. Turtle is a ….. 2. To give a command to the turtle you type in the……. 3. The correct way of giving a forward command and operating it is….. 4. If the turtle is given a wrong command, Logo will give an error message in the…… 5. Once the turtle has turned, it will take the next turn from.
Task management skills	Being able to deal with the responsibilities and expectations of the LOGO environment.	10, 13, 14, 15 and 17	1. To erase all the lines from drawing area you give the command….. 2. To bring the turtle to its HOME position, you give the command. 3. The MSWLogo Screen is divided into …….. sections 4. One can see the hidden turtle by using …….. command 5. Giving command RT 90, the turn would be like
Mathematical skills	Being able to draw different shapes and polygons using LOGO software	7, 9, 11, 16 and 18	Draw the following using LOGO software: Circle, Square, Rectangle, Triangle and Pentagon

Adapted from: National Volunteer Skills Centre (2003).

LOGO Package and Administration of Posttest.

Data analysis

Data collected was subjected to inferential statistics which includes T-test and analysis of variance (ANOVA).

RESULTS AND DISCUSSION

Table 2 shows that pupils of age 8 years had 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 means that as the age of the pupils increase, their level of competence in LOGO Programming Language improved. This may be due to the fact that as pupils' age increases, their ability to think and do more creative work increases. The result is also represented in Figure 1.

Findings of this study showed that all age levels in the primary schools were able to open Microsoft Windows LOGO, exit LOGO software, identify LOGO Opening Screen, identify the input box and command the turtle to draw different sizes of circle. The pupils demonstrated 100% competence in all these skills. However, from age six, unlike their age five counterpart, pupils started showing signs of developmental progression in the following areas drawing and geometry, applying the rules/giving commands in LOGO Programming language and executing commands in LOGO to draw different sizes of squares, rectangles, save their works, open their saved pictures, use penerase to clean unwanted lines, and continue the drawings by using penpaint command.

All age levels in the primary schools acquired competence in different modules (Table 3). Age five years old pupils were only able to recognize the LOGO icon, as well as identify the input box and command the turtle to draw different sizes of circles. This age group could not go further because most of them were not familiar with the computer and they could not manipulate

Table 2. Pupils' mean score by age in acquiring competence in LOGO instructional package.

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

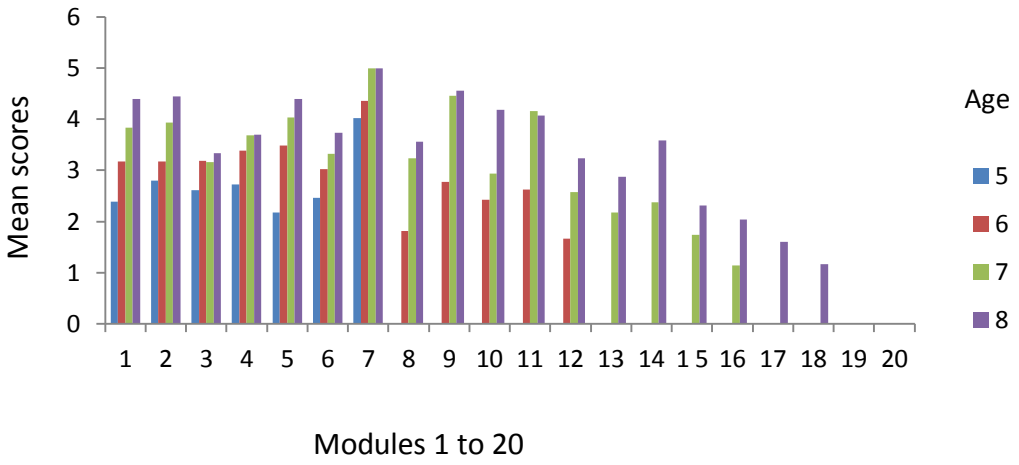

Figure 1. Means Scores of Public School Pupils in LOGO Competence (Modules 1-20)

the mouse and recognize the function keys on the keyboard. According to Rachel (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. The study further acknowledged that children will have different levels of interest, confidence, and prior knowledge and skills. This could be the reason why they could not go further in other modules. Pupils aged six years and above acquired more competence by being able to differentiate between LOGO Main Screen and The Commander Window. Pupils in this age level were competent in applying the rules of giving commands in LOGO Programming Language by being able to use LOGO primitives to draw different sizes of squares as well as displaying some competence in other modules. Pupils of ages 7 and 8 years displayed better competence in modules 15 and 16 while those aged 8 years were able to advance to modules 17 and 18. None of the age groups displayed any competence in the last two modules (19 and 20).

It is therefore recommended that LOGO programming language be incorporated into Nigerian Primary School Computer Studies Curriculum preferably from age. According to Piaget during this stage, intelligence is increasingly demonstrated through the use of symbols while memory and imagination 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. Moreover, it has been reported that body outlines and equipment a child can touch gives him an active role in learning (Huitt and Hummel, 2003). LOGO fits well into this age group 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.

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 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 signify 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 a significant difference in the pretest and posttest achievement scores of primary school. This implies that

Table 3. The age of pupils in relation to competencies mastered in LOGO Programming.

Modules	Contents	Age levels at which Competence is acquired in LOGO
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 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
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
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
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
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
15 – 20	Module 15: PenPaint. Pupils were unable to use the command PENPAINT	7 and 8
	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.	7 and 8
	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	8
	Module 18: Teaching the turtle to draw POYGONS. Pupils were unable to draw different types of Polygons	8
	Module 19: Changing PEN COLOUR. Pupils were able to change the PEN color	None
	Module 20: Letter Graphics in LOGO. Pupils were unable to Use all the LOGO Primitives to make different designs and other graphics like alphabets	None

Table 4. 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	23.79	8.29	53.56	348	.000*
PREACHVT	349	4.10	2.49	.13					

*Significant at p < .05.

Table 5. 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		
Within groups	20070.00	345	58.17	45.941	.000*
Total	28087.70	348			

*Significant at p < 0.05.

treatment has gainful impact on children exposed to learning environment.

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

From Table 5, 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 LOGO Programming Language is significantly different across age levels.

CONCLUSION

Teaching pupils the act of programming at early age is one of the ways in which Nigeria can get to the top in ICT world. Experience with LOGO Programming Language in this study suggests that young children can actively engage in computer programming activities in ways that are consistent with developmentally appropriate practice. Results showed that there was a significant difference in pupils' competence in LOGO Programming Language after exposing them to LOGO Instructional Program. The study also shows that computer programming competency increases with age as the pupils' ability in LOGO programming also improves with age. LOGO Programming Language should therefore be included in computer studies curriculum for primary school pupils' in Nigeria and should be introduced as early as primary one, which is the class for pupils of age six.

REFERENCES

Agbatogun AO (2010). "Gender, Academic Qualification and Subject Discipline Differentials of Nigerian Teachers' ICT Literacy". Acad. Leadersh. The Online J. 8(1).

Barak M (2006). Instructional principles for fostering learning with ICT: teachers' perspectives as learners and instructors. Educ. Inform. Technol. 11:121-135, DOI 10.1007/s11134-006-7362-9.

Clement DH (2002). Computers in Early Childhood Mathematics. Contemporary Issues in Early Childhood *3(2).*

Clement DH, Sarama J (2002). The role of technology in early childhood learning. Teaching children mathematics, 8(6):340-343. EJ 658 166. (Also available: http://my.nctm.org/eresources/view_media.asp?article_id=1897 Comput. Educ. 1-220.

Delgelman D, Free JU, Scarlato M, Black JM, Thomas G (1986). Concept Learning In Preschool Children: Effects of a short-term LOGO experience. J. Educ. Comput. Res. 2(2):199-205, EJ 336 306.

Emihovich C, Gloria EM (1988). Effects of LOGO and CAI on Black First Graders Achievement, Reflectivity, and Self-Esteem. Elem. Sch. J. 473-487.

Federal Ministry of Education (FME) (1988). Report on National Policy on Computer Education. Lagos: NERDC Press.

Gillespie CW, Beisser SR (2001). Developmentally appropriate LOGO computer programming with young children. Inform. Technol. Child. Educ. Ann. 232-247. EJ 639 714.

Harrison C, Comber C, Fisher T, Haw K, Lunzer E, MCFarlane A, Mavers D, Scrimshaw P, Somekh B, Waatling R (2002). ImpactCT2: The impact of Information and Communication

Huitt W, Hummel J (2003). Piaget's theory of cognitive development. *Educational Psychology Interactive.* Valdosta, GA: Valdosta State University. http//www.edpsycinteractive.org/topics/cogsys/piaget.html.

Lim CP, Hung D, Wong P, Hu C (2004). The pedagogical design of ICT integration in online learning: A case study. Int. J. Instr. Media 31(1):37.

Look D (2005). Discussion Paper: Impact of Technology on Education, PUSD Excellence Committee, December 2005. Available from http://pleasanton.k12.ca.us/Superintendent/Downloads/Technology.pdf.

Kozma RB (2005). ICT and Educational Reform in Developed and Developing Countries. Centre for Technology in Learning SRI International, 333 Revenswood Ave. Menlo Park, California 94025 USA

Morris MG, Venkatesh V, Ackerman PL (2005). Gender and age differences in employee decisions about new technology: an extension to the theory of planned behavior, IEEE Trans. Eng. Manage. 52(1):69-84.

Nigerian Education Research and Development (NERDC) (2007). 9-Year Basic Education Curriculum for Computer Studies.

Plowman L, Stephen C (2003). A 'benign addition'? Research on ICT and pre-school children. J. Comput. Assist. Learn. 19:149-164.

Rachel B (2004). The role and potential of ICT in early childhood education: review of New Zealand and international literature. New Zealand Council for Educational Research, v.

Resnick M (2001). Closing the fluency gap. Communication of the ACM, 44(3):144-145.

Sharp C (2002). School Starting Age: European Policy and Recent Research. Paper presented at the LGA Seminar 'When Should Our Children Start School?' London.

http://www.nfer.ac.uk/research/conference_list.asp
Tomei LA (2005). Taxonomy for the technology domain. USA: Inform. Sci. Publish. 13:270.
Vincent J (2001). The role of visually rich technology in facilitating children's writing. J. Comput. Assist. Learn. 17(3):242-251.
Voogt J, Gorokovatschke Y, Pourycheva N (2000). The integration of ICT in preservice teacher education: A pilot project at three teacher-training colleges in St. Petersburg, Moscow, and Amsterdam. Educ. Technol. Res. Dev. 48(3):121-125.
World Bank (2002). Information and Communication Technologies. A world Bank Group Strategy Washington D. C.: The World Bank Group.
Yi Y.D, Wu Z, Tung LL (2005-2006). How individual differences influence technology usage behavior? Toward an integrated framework, J. Comput. Inform. Syst. 46(2):52-63.