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Address:-Ashok Yakkaldevi 258/34, Raviwar Peth, Solapur - 413 005 Maharashtra, India
Cell : 9595 359 435, Ph No: 02172372010 Email: ayisrj@yahoo.in Website: www.isrj.net

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ORIGINAL ARTICLE

EFFECT OF BRAIN-BASED ADAPTIVE LEARNING STRATEGY ON ACADEMIC COMPETENCE OF STUDENTS WITH LEARNING DISABILITY

ADIMORA, DOROTHY EBERE (PhD); AKANEME, IMMACULATA NWAKAEGO (PhD); AKUBUILO, FRANCIS (PhD); EYA, EDITH NGOZI (M.ED)
FEDERAL COLLEGE OF EDUCATION EHA-AMUFU; ONAH, UCHE HOPE (M.ED); UMEANO, ELSIE CHIZUA (Professor)

Faculty of Education, University of Nigeria, Nsukka.

Abstract:

The study investigated the effect of brain-based adaptive learning strategy on academic competence of students with learning disability. The study adopted a quasi experimental non-equivalent control group, pretest-posttest research design. The population was all the 1,242 students in senior secondary two (SS11) in Igbo-etiti LGA in Nsukka urban Education Zone, Enugu State, Nigeria. The sample was 86 (41 males and 45 females) SS11 students with dyslexia learning disability composed from two public schools that were purposively sampled from the study area. Two instruments were used for the study. They are 32-item Academic Competence Evaluation Scale (ACES) adapted from DiPerna and Elliott (2000) and a 20-item test named Brain-based Learning Strategy Test (BLST)(researcher constructed). The instruments were validated by two experts in educational psychology and one in measurement and evaluation all in Faculty of Education, University of Nigeria, Nsukka. It was trial tested using cronbach alpha procedure and reliability coefficient of the ACES was 0.87 while that of the BLST test items was 0.82. High mean rating indicates that the academic competence is on the high side. Mean and standard deviation were used to answer the research questions and the hypotheses were tested using the Analysis of Covariance (ANCOVA) at 0.05 level of significance. It was found that brain-based adaptive learning had a significant effected on the academic competence of students with DLD and that gender has no significant influence on academic competence of students with DLD exposed to it. Based on the findings of this study, it was recommended among others that government, school administrators, educators, curriculum planners and school teachers should put concerted effort to adopt learning intervention programme such as Brain-based Learning Strategy that can enhance the academic competence of students with learning disability.

KEYWORDS:

Brain-based adaptive learing, Attention, Memory, Emotion, Academic competence.

1. INTRODUCTION

In the recent time, society is faced with multifaceted challenges in the field of education. It is not only on education expansion and educational universalisation but also how to improve the overall quality of

education. This quality of education demands students to remain active in classroom throughout the teaching process so as to have education permeate through them. Students' inability to understand materials being read or classroom instructions has been a pervasive problem in most institutions of learning especially in secondary schools. This problem has, for instance, demotivated some of the students and has resulted in their being unprogressive and loss of interest in becoming confident learners in their academics. In order to address this problem, it then becomes imperative to identify the individual problems of these students. In some schools, certainly, some students that encounter difficulty in reading and understanding the classroom instructions are consequently labeled never do well or students with learning disability.

Learning disability is an umbrella term for a wide variety of learning problems. They refer to a number of disorders that may affect the acquisition, organization, retention, understanding, or use of verbal or non-verbal information. Learning disabilities result from difficulties in one or more processes related to perceiving, thinking, remembering, learning, language processing, phonological processing, visual spatial processing, processing speed, memory, attention, and executive functions such as in planning and decision-making (Living document, 2009). This implies that an individual with actual learning disability is either born with those issues or acquires them through events such as a brain/head injury (Vargo & Young, 2011). Such deficits are in the form of - learning disabilities in reading (dyslexia), in math (dyscalculia), in writing (dysgraphia), in motor skills (dyspraxia), in language and in reading comprehension (aphasia/dysphasia), auditory processing disorder – difficulty hearing differences between sounds and problems, and visual processing disorder - difficulty interpreting visual information (Kemp, Smith & Segal, 2012). These deficits affect how the concerned individual receives and processes information (Synaptic Global Learning, 2012).

However, in the present study, the researcher is interested in dyslexia learning disability, this is because dyslexia is the learning disability that is mostly apparent in school learning as it usually revolves around reading and writing (Dyslexia Information Page, 2010). In a further explanation, dyslexia is broadly perceived as a learning disability that impairs a person's fluency or comprehension accuracy in being able to read, and which can manifest itself as a difficulty with phonological awareness, phonological decoding, orthographic coding, auditory short-term memory, or rapid naming. According to Jensen (2008), dyslexia is a disorder in children who, despite conventional classroom experience, fail to attain the language skills of reading, writing, and spelling commensurate with their intellectual abilities. A type of dyslexia that can affect a child's ability to spell as well as read, is trauma dyslexia that usually occurs after some form of brain trauma or injury in the area of the brain that controls reading and writing. Kemp, Melinda and Jeanne, (2012) however, opined that there are two types of dyslexia; they are basic reading problems which occur when there is difficulty understanding the relationship between sounds, letters and words, the second type is a reading comprehension problems which occur as an inability to grasp the meaning of words, phrases and paragraphs.

It therefore, becomes imperative to understand that learners with dyslexia are just as smart as everyone else, still as intelligent as ever, it does not mean that they are lazy or dumb. The thoughts are there even if the words fail to come, the problem is that their brains are simply wired differently and this affects how the concerned students receive and process information. They just need to be taught in a way that is tailored to their unique learning styles. These students seem not to comprehend properly while learning in a traditional classroom or online education models rather they seemingly learn better with special teaching methods that suit their individual needs, such as brain-based adaptive learning strategy (Medicine-Net, 2012).

Brain-based adaptive learning is a comprehensive approach to learning based on neuroscience (Jensen, 2008). Brain-based adaptive learning is an attempt to bring insights from brain research into the arena of education to enhance teaching and learning. Moghaddam & Araghi (2013) opined that brain-based adaptive learning is a natural, motivating, and positive way of maximizing learning and teaching to the ways the brains learn best. Brain-based adaptive learning seemingly strives to provide unprecedented opportunity to dyslexic students to master content by adapting to their learning strategy and giving them a chance to be equal with all other learners in the class. This adaptive learning strategy includes admitting the brain's rules for meaningful learning and adapting teaching with those rules in brain (Jensen, 2005). Therefore, educators who design curricula, lesson plans, or classroom activities cannot ignore this approach because it is apparent that there are factors impacting the learning process. This is in line with information processing as one of the first approaches of cognitive psychology that turned linguists, psychologists, and language teachers toward the function of mind and abstract mental processes in teaching.

This study, therefore, adopts a four dimensional learning strategy - attension, emotion, memory and meaningful learning in collaboration with six suitable tips for brain-based adaptive learning involved in cognitive functioning and development such as repetition, organizing new language, summarizing

meaning, guessing meaning from context and using imagery for memorization - access to simulation, animation, video, audio, games, intelligent feedback, graphics and texts that allow a learner to apply attension, emotion, memory and meaningful learning so as to learn more successfully (Wallace, 2006; Edutopia, 2010). This has been partially driven by a realization that tailored learning cannot be achieved on large-scale using traditional, non-adaptive approaches. It seemingly endeavours the transformation of the learner from passive receptor of information to collaborate in the educational process and expose the learner to an opportunity to remember new words by visualizing them as they are represented in a memorable or ridiculous situation that facilitates the recall of the words (Wallace, 2006). Attention is one area where an information processing approach has claimed costly insights into the workings of the human mind for its advocates. Certainly, some experienced teachers understand that some learners have remarkable difficulty in paying attention to their affair and this invariable habit gives negative effect on learning. Due to importance of attention on learners' learning processes, Williams & Burden (1997) suggest that attention should be seen as a process of filtering out an overwhelming range of incoming stimuli and selecting out only those ones which are important for further processing. Emotion is another important area in information processing approach. Goleman (1995) claims that the emotional mind is faster than the rational mind, where learning best takes place in an atmosphere of unconditional positive regard and can be established when teachers come to see their learners as clients with specific needs to be met. The teachers as a facilitators of learning rather than transferor of raw knowledge (Williams & Burden, 1997). Another area in which information processing can be taken into account is of memory. Studies indicate that memory is not a unitary concept and that different areas of the brain join in the encoding, storing and retrieving tasks. The description and illustration of different sorts of memory and the procedures of the learning process that donate to the stability of memory and later effectiveness of recall have been the concentration of numerous studies. Brown (2000) explained that a cognitive psychologist Ausubel stressed the significance of cognitive processes and on the other side set the concept of meaning at the core of such processes. In fact, Ausubel's advanced organizers strategy is to perform as a bridge between previous obtained knowledge and what they are to know. Ausubel stressed that rote learning includes the mental storage of materials that have little or no connection with existing cognitive structure, on the other hand meaningful learning may be explained as a process of relating and connecting new material to old ones in a hierarchical fashion.

High quality effective learning intervention has been linked to decreases in incidence of problem behaviours; improvements in the relationships that surround each child; increases in academic competence; and substantive, positive changes in school and classroom climates (Laura and Karen, 2010). Such identification seems to be helpful in assisting students to attain improved academic competence. A child's success in school may be jeopardized if the problem remains untreated. No wonder, Mayor Foundation for Medical Education and Research, MFMER (2012) pointed out that dyslexia is distressing, incredibly frustrating and can result in a poor academic competence.

Academic competence is a multidimensional construct consisting of the skills, attitudes, and behaviours of a learner that contributes to academic success. It is a broad intellectual skills essential to all fields of college study. Academic competencies are reading, writting, speaking listening, mathematics, reasoning and studying (Dalena, 2010). Academic competence comprises students' academic skills, study skills, motivation, interpersonal skills, attitudes, behaviours and academic self-concept (DiPerna and Elliott, 2000). DiPerna and Elliott (2000) further explained that skills, attitudes and behaviours contributing to academic competence fall into one of two domains, academic skills – reading/language arts, mathematics and critical thinking; academic enablers – motivation, engagement, study skills and interpersonal skills. These competencies are therefore, needed for effective academic work and successful academic functioning

Gender, another area of interest to the researcher was also explored. Gender refers to the attitude expected of an individual on the basis of being born male or female (Adimora, 2012). With respect to gender, Turnbull, Turnbull, and Wehmeyer (2007) noted that boys are four times more likely to be labeled with a learning disability than girls. A study conducted by Herbert and Stipek (2005) revealed boys higher math competency than girls, and in another study, there was no gender difference with regards to their academic competence. However, gender issue is yet unconclusive since one does not know the effect of gender on the academic competence of students with DLD in secondary schools in Igbo-etiti Local Government Area, Nsukka Education Zone, Enugu State, Nigeria.

STATEMENT OF THE PROBLEM

Oftentimes, many students have learning needs or special needs and go undiagnosed, probably because the teachers do not even know the signs to look for not to talk of applying a desirable intervention

measure to remedy the problem and possibly facilitate their academic competence. There seems to be many students with dyslexia disability in most schools, most of them are engulfed in a traditional learning environment that fails to x-ray their individual differences in academic ability and attend to their academic difficulties. Studies seem to show the efficacy of brain-based adaptive learning strategy in improving the academic ability of students exposed to it. Using the traditional teaching method to teach the students, especially those with dyslexia disability seems to be detrimental to their future as it might lead to inaccessibility to the intervention learning strategy tailored to their individual disabilities with the likelihood of ameliorating their learning difficulty. Students' inaccessibility to learning intervention measure might consequently be detrimental to their academic competence, their future career and the society at large. Therefore, the problem of this study stated in a question form is; what is the effect of brain-based learning strategy on academic competence of students with dyslexia disability in secondary schools in Igbo-etiti Local Government? How does their inaccessibility to brain-based adaptive learning, if it does at all, affect their academic competence? It appears, however, that there is no available study on effect of brain-based adaptive learning strategy on academic competence of students with dyslexia disability in secondary schools in Igbo-etiti Local Government Area, Nsukka Education Zone, Enugu State. The problem of this study, therefore, is that one does not know the effect of brain-based adaptive learning strategy on academic competence of students with disability in secondary schools in Igbo-etiti Local Government of Nsukka Education Zone, Enugu State, Nigeria. The general purpose of this study is, therefore, to investigate the effect of brain-based adaptive learning strategy on academic competence of students with dyslexia disability in secondary schools in Igbo-etiti Local Government of Nsukka Education Zone, Enugu State, Nigeria.

RESEARCH QUESTIONS

The following research questions guided the study:

1. What is the effect of brain-based adaptive learning on the pretest-posttest mean academic competence scores of students with dyslexia learning disability?
2. What are the posttest mean academic competence scores of male and female students with dyslexia learning disability exposed to brain-based adaptive learning?

Research hypotheses

The following null hypotheses were tested at 0.05 level of probability.

Ho_1:Brain-based adaptive learning strategy has no significant effect on the pretest-posttest mean academic competence skills of students with dyslexia learning disability.

Ho_2: There is no significant difference in posttest mean academic competence scores of male and female students with dyslexia learning disability exposed to brain-based adaptive learning strategy.

Method

The method adopted for the study was a quasi experimental non-equivalent pretest-posttest control group research design, the experimental group received treatment on brain-based learning and the control group on the conventional method. The population was made up of all the 1,242 students in senior secondary two (SS11) in Igbo-etiti LGA in Nsukka Education Zone, Enugu State, Nigeria. The sample was 86 (41 males and 45 females) SS11 students with dyslexia learning disability composed from two public schools that were purposively sampled from the study area. The criteria that guided the composition of the sample were the number of students with dyslexia learning disability and the availability of males and females with DLD. In one of the two schools, two intact streams were randomly assigned to experimental method, while two classes in the other sampled school served as the control group. Those in the treatment/experimental school were exposed to brain-based adaptive learning system while those in the control schools were exposed to conventional learning method.

In conducting this study, two instruments were used. The section A of the first instrument contained the demographic data about the subjects (students), while section B contained the Academic Competence Evaluation Scale (ACES) of 24-item statements adapted from DiPerna and Elliott (2000), used to collect data on students' academic competence skills; such as skills, attitudes and behaviours contributing to academic competence that fall two domains, academic skills– reading/language arts, mathematics and critical thinking; academic enablers– motivation, engagement, study skills and interpersonal skills. It was a four-point rating scale meant to determine the academic competence of

students with DLD in the public secondary schools in the area. The second instrument was the Brain-based Learning Strategy Test (BLST) items. It was a 25-researcher constructed test items named Brain-based Learning Strategy Test (BLST). Essay-type questions were used because answering of the questions will lend itself to academic competence skills through practical academic exercise. Initially, the instrument contained 25-item questions, but in the process of validation by two experts in educational psychology and one in measurement and evaluation in University of Nigeria, Nsukka, and the process of trial testing, the items were reduced to 20. Marking scheme was prepared in line with the demands of the questions. The reliability coefficient of the ACES and BLST were 0.87 and 0.82 respectively. The rating scale for ACES ranged from Very Much True (VMT-4), Very True (VT-3), Moderate True (MT-2) and Slightly True (ST-1). High mean rating indicated high academic competence skills.

EXPERIMENTAL PROCEDURE

Before the experiment, four regular English teachers from the two randomly drawn schools were coordinated on the purpose of the study, content area, use of the lesson notes and general conduct of the study. The coordination lasted for five working days. The four factors in brain-based adaptive learning that impact the learning process such as attention, memory, emotion and meaningful learning in collaboration with five skills in brain-based adaptive learning - repetition, organizing new language, summarizing meaning, guessing meaning from context and using imagery for memorization such as access to simulation, animation, video, audio, games, intelligent feedback graphics and texts were used for the experimental group. These skills were taught using selected topics in SSII intensive English textbook and scheme of work, while the conventional teaching method was used on the control group. Sequel to the experimental treatment, the subjects in the three groups were pretested using the Brain-based Learning Strategy Test (BLST). At the end of the pretest, the two groups were subjected to experimental process by the research assistants (teachers) which lasted for four weeks. Each week contained four periods of 40 minutes per period giving a total of 16 periods for the study. The lesson notes for the two experimental groups were the same in terms of content, instructional objectives, mode of evaluation and the instructional activities.

After four weeks of experimental activities, the research assistants administered the posttest to the two groups. Responses of the subjects from both the pretest and posttest were scored and analyzed. During the treatment, some of the extraneous variables such as teacher variables, test sensitization and the issue of equivalence were reduced to the barest minimum through the coordination, time gap between the pretest-posttest and the uniform marking scheme. Data obtained from the subjects were scored on a minimum of 0 and maximum of 5 marks; and analyzed using descriptive statistics (mean and standard deviation) for the research questions and inferential statistics (ANCOVA) for testing the hypotheses at 0.05 levels of significance. Results of the analysis are presented as shown below.

RESULTS

The results of the study are presented in line with the research questions and corresponding hypotheses.

Research question one and hypothesis one

What is the effect of brain-based learning on pretest-posttest mean academic competence of students with dyslexia learning disability?

Mean scores and standard deviation (SD) of students on brain-based adaptive learning strategy (BLST) by treatment group.

Treatment		Pre-BLST	Post-BLST	Mean gain score
Experimental	Mean	18.23	36.15	17.92
	N	39	39	
	Std. Deviation	3.08	4.28	
Control	Mean	16.35	17.47	1.12
	N	47	47	
	Std. Deviation	3.11	2.66	

Data presented in table 1 above indicate the pretest-posttest mean scores of students with dyslexia disability in the treatment and control groups as well as mean gain scores of the groups. Students with disability exposed to brain-based learning instruction had a pretest mean academic competence score of 18.23 with a

standard deviation of 3.08 and posttest mean academic competence score of 36.15 and standard deviation of 4.28. The pretest-posttest mean achievement gain score is 17.92. The students with dyslexia disability in the control group had a pretest mean academic competence score of 16.35 and standard deviation of 3.11 and posttest academic competence score of 17.47 with standard deviation of 2.66. the pretest-posttest mean gain score is 1.12. The difference in the mean gain score which favours the treatment groups indicated that students with DLD exposed to brain-based learning instruction manifested enhanced achievement in English instruction as against their counterpart in the control group.

This effect of brain-based learning instruction on the pretest-posttest mean academic competence scores of students with dyslexia learning disability was further tested using the corresponding hypothesis.
Ho1: Brain-based adaptive learning strategy has no significant effect on pretest-posttest mean academic competence skills of students with dyslexia learning disability.

Table 2: Summary of the 2 way analysis of covariance (ANCOVA) on the students with dyslexia learning disability academic competence skills in BLST by treatment.

Source of variation	Sum of square	df	mean sum of squares	f	sig.	Decision at 0.05 level
Corrected model	10824.782[a]	4	2621.219	202.596	.000	
Intercept	2869.911	1	2869.911	252.050	.000	
Pretest	26.217	1	26.217	2.155	.145	
Treatment	10764.568	1	10764.568	28.047	.000	*S
Experiment x gender	33.210	1	33.210	2.576	.102	*NS
Error	1489.289	189	12.082			
Total	110029.220	131				
Corrected total	12510.108	129				

a R Square = .829 (adjusted R Square = .828)
*S = Significant at 0.05 level
*NS = Not Significant at 0.05 level

The data presented in table 2 above shows that treatment as main factor had a significant effect on the academic competence of students with dyslexia disability. The adjusted R Square of .829 further suggested that 82% of total variance on the dependent measure was contributed by treatment using brain-based learning strategy. This evidence showed that instruction in brain-based learning instruction was effective in enhancing the academic competence of students with dyslexia disability as compared to those in control group that were not exposed to brain-based learning instruction. The data revealed F-value of 828.047. The hypothesis of no significant effect of brain-based learning instruction on academic competence of students with dyslexia learning disability revealed a significant level of .000 and was therefore rejected.

Research Question Two

What are the posttest mean academic competence scores of male and female students with dyslexia learning disability exposed to brain-based adaptive learning.

Table 3: Mean and Standard Deviation of academic competence of Students with Dyslexia Learning Disability Pretest-Posttest Scores by BLST and Gender.

Treatment	Gender	N	ξ	SD	ξ	SD	Mean Gain Score
Experimental	Male	41	18.20	3.10	36.53	3.97	18.33
	Female	45	18.31	3.19	37.78	4.70	19.47
Control	Male	37	17.76	3.47	18.20	2.86	0.44
	Female	49	17.75	2.77	19.06	2.70	1.31

Results in Table 3 above indicate that the male DLD students in the experimental group had a pre-test mean academic competence score of 18.20 with a standard deviation of 3.10 and post-test mean academic competence score of 36.53 with a standard deviation of 3.97. The mean gain score of male students in the experimental group was 18.33 while their counterparts in control group had a pre-test mean academic competence score of 17.76 with a standard deviation of 3.47, the posttest mean academic competence score of 18.20 with a standard deviation of 2.86. The mean gain score of male students with DLD in the control group was 0.44. The female students with DLD in the experimental group had an academic competence pretest mean achievement score of 18.31 with a standard deviation of 3.19 and post-

test mean achievement score of 37.78 with a standard deviation of 4.70. The mean gain score for the female students in the treatment group was 19.47. Their counterparts in the control group had a pretest mean achievement score of 17.75 with a standard deviation of 2.77, and posttest mean achievement score of 19.06 with a standard deviation of 2.70. The mean gain score for students in the control group was 1.31.

However, the female students with DLD in the experimental group performed better than their male counterparts. Both the male and female students with DLD in the experimental group, performed better than the male and female students in the control group. The difference between the posttest mean achievement scores in academic competence of male and female students with DLD who were exposed to brain-based learning instruction was further tested using the corresponding hypothesis.

Results presented in table 2 above reveal the F-value of 2.576 with respect to gender as main factor to be significant at .102 and thus not significant at 0.05 probability levels. There was, therefore, no significant difference in the posttest mean achievement scores of the male and female students in test of comprehension (TOC). The null hypothesis of no significant difference in posttest mean academic competence scores of male and female students with dyslexia learning disability exposed to brain-based adaptive learning strategy therefore, stands. This shows that the male and female students with DLD benefited equally from the treatment given. Gender was a significant factor on the academic competence attained by students with DLD, and the null hypothesis is, therefore, not rejected.

DISCUSSION

Brain-based learning could be used to track students' academic progress or employed as a tool to evaluate the effects of an educational intervention on students' academic competence. Results of the study show that the effect of brain-based learning on academic competence of students with dyslexia learning disability was significant. Apparently, exposure of students to brain-based adaptive learning technique led to significant improvement in their posttest mean scores as compared to their pretest mean scores and that of the control group. This finding is in affirmation to Jensen (2008) that learning disabilities such as dyslaxia come from anomaly in the brain pathways functions that connect with the hippocampus - the central processing unit of the brain which triggers neural pathways, and that the provision of diagnostic assessment on learning media, models and interactivity in brain-based adaptive learning system seems to make possible the identification of a learning modality that fits well and enable learners to progress with the given learning tasks.

It was also found that no significant mean differences among the male and female students with dislexic learning disability exposed to brain-based adaptive learning was ascribed to the effectiveness of the intervention programme in enhancing the students academic competence irrespective of gender. This result seem to disagree with the finding by Turnbull, Turnbull and Wehmeyer (2007) that boys are four times more likely to be labeled with a learning disability than girls, while Herbert and Stipek (2005) revealed boys higher math competency than girls. This finding of the present study seem to affirm a study carried out by Adimora (2012) which revealed no significant interaction effect of comprehension monitoring strategy and gender on mean achievement of low-achieving secondary school students in reading comprehension.

CONCLUSION

Exposure of students with dyslexic learning disability to brain-based adaptive learning strategy significantly affects their academic competence. Therefore, exposing students especially students with learning disability to a learning intervention programme such as brain-based adaptive learning is associated with enhanced academic competence skills.

RECOMMENDATIONS

Government, school administrators, educators, curriculum planners and school teachers should put concerted effort to incorporate learning intervention programme that is capable of identifying individual differences in learning and tailor the classroom instruction to addressing such problems to enhance academic competence of such problem learners.

There should be seminars and workshops to enlighten teachers on the specifics and techniques, to enable them diagnose how the learning disability affects their students, and also learn to provide information in chunks to the students as large amount of information at a time might be difficult for the brain to process.

Male and female students with DLD should be exposed equally to the learning intervention programme in order to benefit equally. There should be no gender sensitivity in the learning intervention programme, in

order not to deny any student access to it.
Educators who design curricula, lesson plans, or classroom activities should not ignore the fact that neuroscience furnishes a biological and physiological foundation for effective teaching trains.

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ADIMORA, DOROTHY EBERE (Ph D)
Faculty of Education, University of Nigeria, Nsukka