Raising Cognitive Ability and Achievement Levels of Some Nigeria Students in Home Economics Using Cognitive Acceleration Training Programme

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ABSTRACT

This study examined the effect of Cognitive Acceleration Training Programme (CATP) on cognitive ability and achievement of Upper Basic II Home Economics students in East Senatorial District of Kogi State Nigeria. The study adopted quasi-experimental design of a non-randomized pre-test post-test control type. The sample consisted of 390 (196 males and 194 females) students drawn from eight schools using purposive sampling technique. CATP in addition to Home Economics Achievement Test (HEAT) and Australian Council for Educational Research (ACER) test with reliability coefficients of 0.95 and 0.82 respectively were used for data collection. Data were analyzed using mean and standard deviation to answer research questions and Analysis of Covariance (ANCOVA) to test the hypotheses at 0.05 alpha level. Findings revealed that students that were exposed to Cognitive Acceleration Training Programme (CATP) in addition to the conventional strategy of teaching exhibited higher achievement (1,379 = 214.961, p=0.00). It is found that students with low cognitive ability level benefited more from CATP. There is significant difference in the mean gains in cognitive ability and achievement scores among low, moderate and high cognitive ability students' exposed to cognitive acceleration training programme (F 2, 211=2.975,P =0.05; F 2, 211 =5.737, P=0.004). Based on the findings it is recommended that CATP be introduced into upper Basic School Curriculum in order to enhance students' achievement in Home Economics. In service training, seminars, workshops and symposia should be organized by the state and federal ministry of education for training of teachers on the use of CATP in schools.

Keywords: Cognitive ability, Cognitive acceleration, Achievement, Low, Moderate and high cognitive ability, Home economics.

Highlights of this paper
- Students' achievement in Home Economics was greatly influenced by their exposure to Cognitive Acceleration Training rogramme (CATP) and it was significantly higher than their counterparts who were exposed to only the conventional method of teaching Home Economics.
- The study provided empirical evidence that the use of CATP enhanced the students' cognitive ability and also increased their achievement in Home Economics.

1. INTRODUCTION

Learning is permanent change in behaviour as a result of past experiences. Gbamanja (2002) states that it is a process which causes a change in the behaviour of an individual. This change results from experience or interaction between the individual and his environment. For learning to take place, there must be a link between what has been learnt and what is being taught otherwise, there will be a breakdown in communication. The ability to do this linking effectively depends on the information processing capability of the student, which is the stronghold of cognitive studies. Cognitive studies mean the studies of mental processes including how people think, perceive, remember and learn (Hock, 2009).

Cognitive abilities, according to Lathan (2009) are brain-based skills and mental processes that are needed to carry out any task from the simplest to the most complex. Some people obviously and consistently understand new concepts quicker, solve unfamiliar problems faster, see relationships that others do not, and are more knowledgeable about a wider range of topics than others. Psychologists have developed tests to measure these traits. Such tests are referred to as test of cognitive ability. These measures of cognitive ability are presented in scores of performances. Based on the summary of the grading system, according to Omotosho (2013) where less than 40% indicates that the students' performance does not meet the minimum academic criteria. In other words, they have low cognitive ability. Scores of 40-59 indicate that the students' performance is average. They are of moderate cognitive ability while students who score 60 and above indicate that they have high cognitive ability. A student who scores less than 40% in a standardized test of cognitive ability cannot achieve mastery and cannot recall reasonably stored information, within a reasonable amount of time. The student demonstrates absence of both judgment and independent thinking. Such a student is said to have a low cognitive ability. A student, who scores 40-5(%) in standardized test of cognitive ability, is said to have performed satisfactorily but with significant short comings. The student demonstrates a limited degree of judgment and independent thinking. Such student can be said to have moderate cognitive ability, while students who score 60% and above in a standardized test of cognitive ability infer that they can achieve mastery, recall stored information and can demonstrate sound judgment and a very good degree of independent thinking. Such students can be said to have high cognitive ability. The worry here is what teaching approach could enhance the achievement or attainment of high cognitive ability? Several approaches have been propounded. Approaches like the conventional methods of teaching (discussion method), creating knowledge inquiry, Self-Directed Learning approach and simulation technique to mention but a few. However, cognitive acceleration training programme (CAPT) seems most preferred since it provides interactive environment thereby enhancing active participation of the learner. It is also preferred due to its constructive nature. Its nature involves participating in various activities which involves challenging student's thinking, focusing on the social construction and understanding, encouraging and enhancing opportunities of meta-cognition.

Cognitive acceleration is an approach to teaching designed to develop students' thinking ability. This intervention programme was first developed by Shayer and Adey (1981) at Kings' College, London. The approach builds on the work by Piaget (1956) and Vygosky (1978) and takes a constructivist approach. Cognitive acceleration (let's think) is a programme which was aimed at the development of students' thinking so that they become more intelligent, and faster at problem solving. Cognitive acceleration is aimed at improving progress towards higher-

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order thinking skills, or what Piaget terms "formal operations". It is a programme that focuses on enhancing pupils' capabilities in thinking, critiquing, selecting and updating information.

Although cognitive acceleration programmes could be considered as a potential solution for the prevalent poor development of thinking skills in many schools today, the problem is complex due to factors such as teachers' preparedness and curriculum content. Some teachers may not have yet developed these thinking skills, and thus, may feel uncomfortable or threatened when trying to work with activities that they themselves found challenging. Thinking skills have also not had a strong presence in most schools or subject curricula, as emphasis is on content knowledge rather than on skills. This has led to most teachers working in classrooms to have limited idea about the meaning of thinking skills and that such skills could be promoted in the classroom, with just a small group of them claiming that promoting thinking is an important objective of teaching. Cognitive acceleration programme consists of 15 to 30 activities intended to be used over three or six months as the case may be. The activities are grouped into particular types of thinking called reasoning patterns, which underlie all high-level thinking and can be applied to many different contexts. Each activity has detailed instructions for the teacher and may have sample materials that can be copied for learners.

It should be noted, however, that factors that affect performance, go beyond cognitive acceleration and cognitive ability but, may depend on other variables such as the sex of the learner. Gender consideration is relevant in this study as males are underrepresented in Home Economics world over, including Nigeria (Achor *et al.*, 2012). Gender factor is equally important in cognitive studies as socialization and sex role stereotypes are found to wield influence in students' cognitive abilities and achievement. It suggests for instance that, a given student is best taught by person of a certain sex or culture. The question therefore is, how does gender affect students' cognitive ability?

This study examines the effect of cognitive acceleration training programme on students' cognitive ability and academic achievement in Home Economics. It also examines the effects of cognitive acceleration training programme on low, moderate and high cognitive ability students. This achievement is measured in relation to Home Economics objectives, as in the National Core Curriculum for Home Economics at the Upper Basic two school levels in Nigeria.

2. THEORETICAL FRAMEWORK

Two theories are relevant to this study. They are Piaget's theory of cognitive development and Vygotsky's social development theory.

Jean Piaget, a Swiss psychologist propounded the theory of cognitive development in human beings in 1956. The theory deals with the nature of knowledge and how it is gradually acquired, constructed and used. It holds that the human mind builds cognitive structures that take external sensory input and interpret, transform and organize it. Piaget maintained that cognitive development is a progressive reorganization of mental processes as a result of biological maturation as well as environmental experience. That is, behaviour (adaptation to environment) is controlled through mental organization called schemata that the individual use to represent the world and design action. This adaptation is driven by a biological drive to obtain balance between schemata and the environment (ie, equilibration).

Piaget hypothesized that the individual and the environment are continuously engaged in a dialogue of interaction (reflexes), that leads to new perception of the world and new organizations of knowledge. He described two processes used by individual in his/her attempt to adapt namely, assimilation and accommodation. An individual must adapt to physical and mental stimuli. These two processes are responsible for how students learn

and adapt schema-assimilation and accommodation. Assimilation means incorporating new experiences within old ones while accommodation is modifying old thinking structures to fit new structures.

Piaget identified four (4) stages of cognitive development which are (i) Sensorimotor Stage (infancy: 0-2 years) (ii) Pre-operational stage (Toddler and early Childhood: 2-7 years): (iii) Concrete operational stage (Elementary and Early Adolescent: 7-11 years) and (iv) Formal operational stage (Adolescent and Adulthood 12-15).

There is the need to use wide variety and suitable learning experiences of concrete nature to help the students to learn (activity based, manipulative, field trips, working in groups to get experience (seeing from others' perspective) through the use of multiple teaching and learning strategies which students individually need to become more active constructors of their own knowledge (their own schemas). It happens through students experiences which encourage assimilation and accommodation. Cognitive acceleration may provide learning that helps expand the learner's conceptual ability and provide a wide range of opportunities so that, they can appreciate the various abilities they possess. Using cognitive acceleration training programme may provide interactive environment and enhance active students' participation in learning thereby providing them the opportunity of understanding Home Economics, especially as it applies to day to day living.

Most students in Upper Basic II ought to be in the formal operational stage of intellectual abilities or development. Here their reasoning is logical and they ask open-ended questions that require logical argument and reason. In most cases, they operate below their expectations, therefore they need assistance inform of methods of instruction that actively involve them. As the students are involved in the cognitive acceleration training programme, each of them will need to be informed by the teacher to share their experience/idea in order to carry along with those cognitive over load or under load. Piaget encourages students' engagement with their environment for the purpose of meaningful interaction and knowledge which is the hallmark of learning. For learning to occur, instructional materials must be in line with what the learner can and should do at a particular cognitive level. This study is de-limited to Upper Basic Two (ages 12-14) which fits into Piaget's formal operational stage (Adolescent and Adulthood), a stage where learners have developed the capacity to engage in formal logic, when they are capable of thinking systematically. It is also the stage where learners can solve problems independently.

Vygosky (1978) theory of Social Development is one of the foundations of constructivism which was propounded by Vygotsky, a Russian psychologist, in 1978. It states that social interaction precedes development and that consciousness and cognition are the end products of socialization and social behaviour. The theory addresses three concepts namely, social interaction, the More Knowledgeable Others (MKO) and the Zone of Proximal Development (ZPD).

Social interactions have a significant role in the process of cognitive development. Invariably, a child's cognitive development is strongly related to social and cultural activities. Vygotsky maintained that knowing can best be advanced through interaction with others in cooperative activities and that every function in a child's cultural development can be seen on the social and individual levels.

The More Knowledgeable Other (MKO), according to Vygotsky, refers to someone who has a better understanding or higher ability level than the learner, with respect to a particular task, process or concept. The MKO is a teacher or an older adult. Many times, students' peers or an adult student may be the individual with more knowledge or experience. On the zone of proximal development (ZPD), Vygosky (1978) described it as the distance between the actual development level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers. Learning occurs in this zone.

When a student is at the ZPD for a particular task, providing the appropriate assistance will give the student enough of a 'boost' to achieve the task. A concept which is difficult to learn or master alone can be learned under the guidance and assistance of the teacher or an expert. As soon as the students are able to master the task, the guidance and assistance can then be removed and students will then complete the task again on their own. Since students construct their own knowledge and understanding, they need to be involved actively in learning and need not be passive learners.

Vygotsky's theory is relevant to this study because, the principle of the theory can be used to help upper basic two Home Economics students in their achievement and academic engagement in Home Economics through activities. The Home Economics teacher must assist (ie, act as a facilitator) and guide the students to think for themselves. The teacher is more knowledgeable than the Upper Basic two Home Economics students. Therefore, his or her interaction with them or between peers helps the students to understand the lesson with ease. With the use of CATP the Home Economics teacher provides activity-based tasks then, provides assistance and guidance instead of claiming to be a store house of knowledge; in the process they socialize as they interact. The theory emphasizes how children actively construct their knowledge and understanding rather than being passive learners in the classroom. The upper basic two Home Economics students are presented with a task to work together in groups and create academic contests to complete a specific task. In this case, participating actively in group activities could help upper basic two students to improve their social and academic engagement in Home Economics lessons. With the exposure of the Home Economics students to CATP the students could strive to think independently so as to contribute positively in the interactive sessions, which is the hallmark of cognitive acceleration.

The level of actual development that the student has already reached, is the level at which the leaner is capable of solving problem independently. The level of Zone of Proximal Development (ZPD) is the level that the student is capable of reaching under the guidance of a teacher or in collaboration with peers. The learner or student is capable of solving problems and understanding materials at this level that they are not capable of learning at the level of their actual development. The level of potential development is the level at which learning takes place. It comprises cognitive structures that are still in the process of maturing but which can only mature under the guidance of the facilitator or collaboration with peers.

3. STATEMENT OF THE PROBLEM

The present decline in enrolment and under achievement in Home Economics at the Upper Basic three Examination over the years has called for concern. The problem shows the students inability to cope with the cognitive demand of the Home Economics Curriculum for upper basic two. If the students are unable to cope with the conceptual demand, certainly they will not achieve much. So, something needs to be done to change this situation, and that something hopefully is to accelerate the cognitive ability of the students through a well designed programme that teachers should use to help the students. Although there has been a great deal of work in the last decade with regards to effect of selected cognitive acceleration programmes on cognitive ability, there seems, however, to be few or none specific to Home Economics known to the researcher, especially in Eastern Senatorial District of Kogi State Nigeria.

The effect of low cognitive ability on students of Home Economics is colossal. For instance, 42% of candidates who sat for Home Economics in Kogi East Junior Secondary School Examination between 2005 and 2014 could not pass (with credits 1-6, see appendix). It could also hinder them from attaining the academic height they desire, just as it could hamper their acquisition of vocational skills required for entrepreneurship and consequently, puts them

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at disadvantage in the labour market. The problem of the study, posed as question therefore is, what are the effects of cognitive acceleration training programme on students' cognitive ability and academic achievement in Home Economics in the East Senatorial District of Kogi State?

4. PURPOSE OF THE STUDY

The purpose of the study was to find out the effects of cognitive acceleration training programme on students' cognitive ability and achievement in Home Economics. Specifically the study intended to:

1. Find out the difference between the mean cognitive ability score of students who are exposed to cognitive acceleration programme and those taught Home Economics using conventional strategy.
2. Find out which of the cognitive ability level students (that is low, moderate and high) benefited more from the cognitive acceleration training programme.
3. Find out the mean achievement score of low, moderate and high cognitive ability level students in HEAT when exposed to cognitive acceleration training programme.

5. RESEARCH QUESTIONS

The following research questions raised guided this study:

1. What is the difference in the measure of cognitive ability between students who are exposed to cognitive acceleration training programme and those taught Home Economics using conventional strategy only?
2. Which of the cognitive ability level students (that is, low, moderate and high) benefited more from the cognitive acceleration training programme?
3. What is the difference in the mean achievement scores of low, moderate and high cognitive ability students in HEAT when exposed to cognitive acceleration training programme?

6. HYPOTHESES

The following hypotheses formulated were tested at 0.05 level of significance:

Ho_1: *There is no significant difference in the mean score of students in Home Economics measure of cognitive ability between those exposed to cognitive acceleration training programme and those taught Home Economics using conventional strategy only.*

Ho_2: *There is no significant difference in the mean gains in cognitive ability scores among low, moderate and high cognitive ability level students exposed to cognitive acceleration training programme.*

Ho_3: *There is no significant difference in the mean achievement scores of low, moderate and high ability level students exposed to cognitive acceleration training programme.*

7. METHODS AND PROCEDURE

7.1. Design

The study adopted a quasi-experimental, the non-randomized pre-test, post-test type of research, which consists of two groups experimental and control. Both groups were pre-tested and post-tested but only the experimental group received treatment. This design was adopted because it is the most appropriate in determining the effect of independent variable (cognitive acceleration) on the dependent variables (achievement).

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7.2. Population, Sample and Sampling

The population of the study was 7,800 Upper Basic II Home Economics students drawn from 195 secondary schools that offer Home Economics out of the 225 grant aided secondary schools in the senatorial district. According to statistics from Kogi State Ministry of Education there are 195 schools that offer Home Economics in the Upper Basic II classes. A feasibility study of the 195 schools revealed that 7,800 students enrolled in these schools for the 2017/2018 academic session.

The sample for the study consisted of 390 Upper Basic II students made up of 196 males and 194 females. The sample size of 390 students is 5% of the total population. This sample is based on the view of Achor and Ejigbo (2006) that a sample size of 10% of the population is adequate for a large population but sample could be lower or higher say 5% or 20% depending on the population or nature of the study. The 5% option is however preferred for convenient purpose as the study is experimental with emphasis on control of variables. However, only 380 upper Basic students were able to complete the experimental process. Purposive sampling technique was used to select eight public schools from the study area. Intact Home Economics classes were used for the study in all the selected schools. The subjects were students between the age brackets of 12-14 years which tallied with the formal operational stage of Pigget's Theory of Cognitive development that are in Upper Basic two for the 2017/2018 session.

An intact class was used for the study in each of the selected schools. The names of the schools were written on sheets of paper and squeezed. The first four to be picked were the experimental classes while the last four were the control classes. In all eight intact classes one arm each from the selected schools was used for the study.

7.3. Instrumentation

Three main instruments were used for the study. They include the Cognitive Acceleration Training Programme (CATP), Home Economic Achievement Test (HEAT), Australian Council for Educational Research (A.C.E.R.) Standardized Aptitude Test.

i. *Australian Council for Educational Research (ACER) Test*

The ACER test is a standardized test set by the Australian Council for Educational Research. It has 35 items. ACER test was used to test the students' cognitive ability. This was used to group the student according to their ability i.e. high, moderate and low. ACER cognitive ability is made up of three sections A, B & C. Section A sought the personal data of the subject, section B is made up of five examples while section C is the main questions to be answered by the students (subjects). The test had six options and the subjects were expected to write the correct option or options in the bracket provided for the purpose after each question.

Australian Council for Educational Research is most appropriate for this work hence it is used to test the cognitive ability of students. Australian Council for Educational Research has been in use in Nigeria. Unwaha (2011) used it in Ankpa to group students according to their ability level. To re-determine the suitability in Nigeria and in Kogi East it was subjected to reliability analysis using Kudar Richardson 21 (KR 21).

ii. *Home Economics Achievement Test (HEAT)*

Home Economics Achievement Test was developed by Ejeh (2011). It was designed by the researcher to assess the level of acquisition of the required learning objectives of students in Home Economics. Home Economics Achievement Test was adapted in this study to test the level of acquisition and achievement of Upper Basic two Home Economics objectives based on the Upper Basic two Home Economics Curriculum. Home Economics

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Achievement Test was a twenty five item multiple choice questions (option A to E). Twenty-five questions were added in order to cover all the topics in the curriculum. Home Economics Achievement Test was validated and also subjected to reliability.

iii.   Cognitive Acceleration Training Programme (CATP):

Cognitive Acceleration Training Programme is a five lessons training programme adopted from the training programme originally designed by Adey and Shayer (1990). Each lesson had activities to be performed by the students under the guidance of the teacher. Cognitive Acceleration Training Programme is made up of five major lessons. Lesson one emphasized the term variables and values, variables and relationships between variables were introduced together with recognizing the possible relationships between two variables. Lesson two introduces the term 'input' and 'outcome' variables which could be an alternative to the more usual but confusing terms-independent and dependent variables. This lesson gives the students the opportunity to express different kinds of relationships in their own words.

Lesson three compared input and outcome variables in two different investigations to show how graphs can be used as pictures of relationships between two variables. The emphasis of this lesson was on learning to read graphical information and not on the skills of plotting a graph. Lesson four had to do with the 'fair' test this investigation involves looking for relationships and no relationships between three input variables and one output variable. In this lesson very little guidance was given to the students so that they had to construct a 'control of variable' strategy for themselves. Students were expected to have cognitive conflict at a high level. Lesson five continues to work on controlling variables but at a more demanding level. Students worked with a multivariable problem, rolling a variety of different 'roller balls' down a track to hit a 'target ball'. Variables must be controlled if any conclusion was to be drawn about the effects of height of release of roller ball, its mass or size on the distance the target ball travels.

Cognitive Acceleration Training Programme is not a test where scores can be obtained rather it is a training lesson that can be used in achieving an aim. Cognitive Acceleration Training Programme does not offer a definition of good teaching although; it provides guidance to effective classroom practice for particular outcomes. Cognitive Acceleration Training Programme is not a magic bullet but it does provide – for teacher that realizes this – a sample scheme from which general teaching/learning principles can be learnt. Cognitive Acceleration Training Programme has been used variously in nations like England, Australia Japan and also in Nigeria. Cognitive Acceleration Training Programme is preferred in this study because it is the most appropriate at this stage (formal) of development which tallies with the Upper Basic II students.

iv.   Lesson Note

These are the lesson plans that were used in teaching both the experimental and the control groups. The lesson plans contained the activities the students would perform in the course of teaching and learning and the instructional materials that would be used to facilitate and inculcate in the students the skills that would enable them achieve the behavioural objectives as indicated in their curriculum for Note of Lessons.

7.4. Validation of Instruments

To ensure that the items were appropriate and relevant to the purpose of the study HEAT and the lesson plans were subjected to face and content validity by four experts, two from the Department of Curriculum and Teaching, Benue State University, Makurdi, an expert in Home Economics from University of Agriculture, Makurdi and an

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expert in Measurement and Evaluation from Kogi State College of Education, Ankpa. Each of the validators was given a copy of HEAT and the lesson plan, and a copy of the purpose of study, research questions, hypotheses and the table of specification. They were requested to examine the construction, see whether the answers provided were correct as well as the appropriateness of the instrument to the target students. In response, the experts suggested that grammatical flows should be corrected and number of items be increased to 50 for wider coverage. The researcher was to recast items 7, 9, 23, 24, 27, 28 and 32 to cover high cognitive level such as comprehension, application, analysis, synthesis and evaluation.

7.5. Reliability

Home Economics Achievement Test was subjected to psychometric analysis. The psychometric analysis was an attempt to determine the quality of a test in terms of how difficult the test items were, how discriminating the items were and the power of the distracting options. These were done by computing the difficulty, discriminating and distracter indices of the items that were administered to students. Some of the items under HEAT were adjusted/modified in terms of grammatical structure and competence and then selected because of their high difficulty index.

Habor (1999) recommends the following ranges:

1. For difficulty or easiness of indices the acceptable range is from 0.30-0.70.
2. For discriminating index the acceptable range is from 0.30-1.0
3. The distracter index is usually dependent on number of options and 0.33 is ideal for 40 option items.

Items whose discrimination fall within acceptable range of 0.30-1.0 as well as options whose distractors indices fall within acceptable range were accepted. However, items whose options fall below the acceptable level of distractors indices but discrimination indices fall within the acceptable range were adjusted or modified and selected. In all 41 items survived while 9 were rejected. For a round figure only 40 items constituted the final HEAT instrument.

The HEAT and ACER were trial tested on fifty four Upper Basic Two Home Economic students from two schools outside those chosen for the main study. The instrument were administered to the students by the researcher and collected immediately. The test scores obtained from HEAT and ACER were analysed using Kuder-Richardson formula (KR_{21}). This formula was used for HEAT and ACER because the test scores in the items were dichotomously scored (Nworgu, 2010).

The reliability coefficient of HEAT was found to be 0.82 while ACER was found to be 0.95. These values fall within the acceptable reliability coefficient standard range of 0.50 and 0.99 (Nworgu, 2010). Also, according to Dingley (2014) the reliability shows acceptable level of internal consistency as both values were greater than 0.50. These instruments were therefore, adjudged to be reliable.

7.6. Method of Data Collection

Data for the study were drawn from the pre-test and post test scores of HEAT. It involved the procedure for training of research assistants, treatment procedure and intervention procedure, ACER test was used for categorizing the students into low, moderate and high cognitive ability groups and was also used to determine the change in the cognitive ability level of the students after the treatment.

i.   *Experimental Procedure*

The researcher organized one week training for the research assistants who were Home Economics teachers. A day was used to familiarize with the two groups at separate time. Two days were used for the control groups and two days for experimental groups. The training programme covered the following areas:

1.   The use of the lesson notes.
2.   The use of CATP lessons for the experimental group.
3.   The procedure for administering the instruments.
4.   The general conducts of the study.

ii.   *Procedure for Training of Research Assistants*

The Home Economic teachers of the classes to be used in the different schools underwent a week's training. The training lasted for 2 hours on each of the days. This was to prepare them on how to use the pre-planned lessons to teach the students in both the control and experimental group and to facilitate the CATP lessons in the experimental groups.

iii.   *Treatment Procedure*

Treatment lasted for 9 weeks. Two groups (control and experimental) were involved in the study. Both groups were taught using discussion method of teaching during normal class hours for lesson notes. But the experimental group further met for 1½ hours three times a week for the treatmenton topics that are not related to Home Economics. Their treatment programme includes the following:

- *Lesson 1: What Varies?*

This lesson is made up of three activities. These activities are geared towards the introduction of relationship(s) that exist between two variables. In the first activity two types of coloured squares and triangles large enough to be seen by the whole class were brought to the class. The shapes were made from coloured card and laminated. Small, medium and large sizes were of the same dimension in addition to about fifteen books of different sizes. In the second activity four coloured containers A, B, C, and D were brought to the class. Two containers were red and of the same large size; the other two containers were blue and of the same small size. They were weighted with sand or lead shot as follows:

Small blue container A is weighted to have same mass as empty large red container C. Small blue container B is weighted to have same mass as large red container D, which contains a 100g mass. Activity three involves pictures of relationships. A set of cards were brought to the class and used between two pupils and more cards were brought to be used for Home Work. This lesson was carried out in the third week of the experiment.

- *Lesson 2: Two Variables*

This is a "circus" of small investigations of each which involved two variables. Activity one is a simple pulley where mass and force were measured (as the input went up, so did the output). Activity 2 involved pouring the same amount of water into several different containers of different widths (as the input variable-width got bigger the outcome variable, depth, got smaller or vice versa. Activity 3 looked at which surface of drying leaves lost the most water by preventing water loss from different surfaces with vaseline. There was no easy input/out come relationship here. It could not be quantified, only described. The fourth activity was a set of data showing children

of different heights and weights. There was no relationship between the variables. These lessons were carried out in the fourth week.

- *Lesson 3: What Sort of Relationship?*

The lesson is made up of two activities. Activity one was CD-Rom spreadsheet while activity two had to do with full teacher demonstration.

This lesson compared input and output variables in two different investigations to show how graphs could be used as pictures to show relationships between two variables. This lesson moves pupils towards a more quantitative way of analyzing relationships between variables. It began to give pupils access to the differences between extrapolation and interpolation, without using these terms. The emphasis of this lesson is on learning to read graphical information not the skills of plotting a graph for details of the equipment required and the activities. This lesson was carried out in the fifth week.

- *Lesson 4: The Fair Test*

This lesson had to do with the "fair" test. This investigation involved looking for relationships and no relationships between three input variables and one outcome variable. Pupils were asked to find out what affected the note produced by a pipe, length, width or material? In this lesson pupils were expected to select lengths of copper and plastic piping, of different widths made into long, medium and short pipes jumbled together in a tray. They were expected to tap a pipe lightly on the palm of the hand to get notes. The investigation sought to find out which variables affect the note produced for details of the equipment required and the activities. This lesson was carried out in the sixth week.

- *Lesson 5: Roller Ball*

Lesson five continued to work on controlling variables but at a more demanding level, pupils worked with a multi-variable problem, rolling a variety of different "roller balls' down a track to hit a target. Ball variables must be controlled if any conclusions are to be drawn about the effects of height of release of roller ball, its mass or size on the distance the target ball travels. The apparatus was introduced to give pupils something to aid visualization. The real heart of the lesson is in the five thought exercises' pupils discuss to deduce what would make a fair test. Thought exercises 4 and 5 created cognitive conflict because they challenged children's misconceptions, pupils tend to focus on speed and impact (force). Both of these are compound variables and are not directly measurable. This lesson was carried out in the seventh week. After the lessons, a week which was week eight was used to summarize the five lessons. Week nine was used for post-test, marking and compilation of result.

7.7. Control of Extraneous Variables

The researcher employed the following measures to control extraneous variables in the study:

i. Students' interaction: To ensure there is no interaction of subjects across the study groups, subject that belonged to the schools selected were 60 kilometres apart. This is to avoid inter-group contamination. Students from the same group were subjected to the same treatment; either as control or experimental. The case of having experimental and control in the same town, school or local government area was avoided to eliminate inter-group contamination.

ii.   History : These are the historical events such as strikes, changes in curriculum that may occur between the pretest and posttest in addition to the experimental variables. This was controlled by ensuring that the study did not last more than the weeks expected. The study lasted for nine weeks only.

iii.   Effect of testing: This involves the effects which pretest has on the subject (participant). The pretest may serve as learning experience that could cause the subjects (participants) to alter the responses on post test whether treatment is applied or not. The researcher controlled this by reshuffling or re-arranging the pretest question items for use as post test.

iv.   Statistical regression: This operates where groups have been selected on the basis of their extreme scores and may be mistaken for the effect of treatment to avoid the regression that will occur in the post test design as a result, the intact classes was controlled by using analysis of covariance for the data analysis.

7.8. External Validity Threats

External validity threats are threats which affect the study and reduce its relevance and practical applications of the results to the extent that the result and conclusion cannot be generalized to the real world. It addresses the question of generalization of the results.

i.   Hawthorne effects: This occurs when subjects (participants) become aware of the experimental testing in which they change their behaviour as a result of being observed and not the variables manipulated by the researcher. Sometimes it may lead to a fallacious conclusion if it is not carefully controlled. In order to avoid creating any undue attention of bringing in new Home Economics teachers in the sampled schools, regular Home Economics teachers were used as research assistants. The regular Home Economics teachers were involved in both control and experimental groups while the researcher did the supervision. A uniform standard in the lesson was ensured with the researcher's prepared lesson plans with clearly stated objectives to reduce teachers' effect.

ii.   Treatment variations: This is the threat that may pose problem, depending on the procedure of the study. Differences exist as a result of treatments given to two (Control and Experimental) of the subjects (participants) of the same group in different schools by different research assistants which may threaten the validity of the research. In order to ensure the control of this, it was ensured that effectiveness and uniformity was given to all subjects (participants) in a particular group irrespective of the school. The Home Economics teachers were given adequate training as research assistants in order to equip them with the necessary knowledge and skills needed to carry out the experiment. Also, the lesson notes, learning guide, and research assistant lesson guide for experimental and control groups were handed over to the teachers to reduce teachers' effect on the treatment. Schools that were used for the study were school with similar environmental conditions.

8. RESULTS

8.1. Research Question 1

What is the difference in the measure of cognitive ability between students who are exposed to cognitive acceleration training programme and those taught Home Economics using conventional strategy only?

Table-1. Mean of the measure of cognitive ability score and standard deviation of home economics students in the experimental and control groups.

Group		Pre-ACER	Post-ACER	Mean gain
Experimental	Mean	38.10	58.50	20.40
	N	215	215	
	Std. deviation	10.38	9.70	
Control	Mean	38.37	43.62	5.25
	N	167	167	
	Std. deviation	11.09	10.84	
Mean difference			14.88	15.15

Source: Field survey, 2018.

Table 1 reveals the mean of the measure of cognitive ability gain of 20.40 and 5.25 for experimental and control group respectively. This shows that the students who were exposed to cognitive acceleration training programme (experimental group) gain higher than those taught using conventional strategy only (control group) the mean difference is 15.15 in favour of the experimental group. This implies that the CATP is capable of enhancing the students' mental ability.

8.2. Research Question 2

Which of the cognitive ability level students (low, moderate and high) benefited more from the cognitive acceleration training programme?

Table-2. Mean gains of home economics students cognitive ability after exposure to cognitive acceleration training programme.

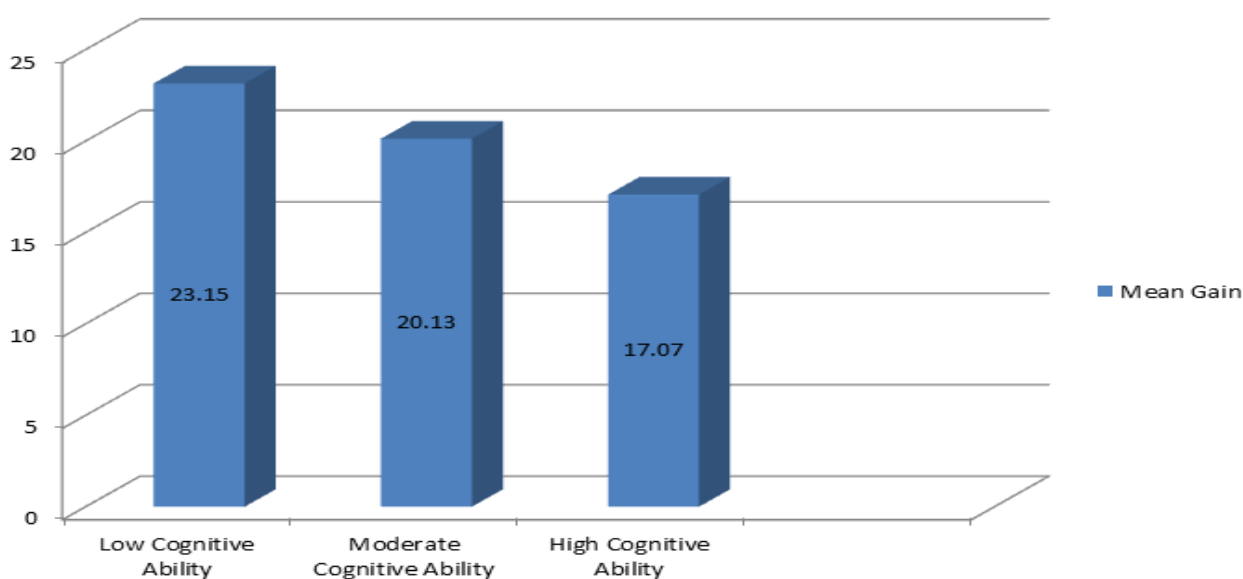| Cognitive ability classification		Pre-ACER	Post-ACER	Mean gain
Low cognitive ability	Mean	27.65	50.80	23.15
	N	79	79	
	Std. deviation	5.80	7.19	
Moderate cognitive ability	Mean	38.84	58.97	20.13
	N	77	77	
	Std. deviation	3.04	6.65	
High cognitive ability	Mean	51.12	68.19	17.07
	N	59	59	
	Std. deviation	4.29	6.59	

Source: Field survey, 2018.

Figure-1. Mean gain level after exposure to cognitive acceleration training.

Source: Field survey, 2018.

Figure 1 and Table 2 show that the low cognitive ability group gained 23.15; the moderate cognitive ability group gained 20.13; while the high cognitive ability group gained 17.07. This indicates that students of the low cognitive ability group gained more from the programme followed by the moderate cognitive ability and then the high cognitive ability being the least (17.07).

8.3. Research Question 3

What is the difference in the mean achievement core of low, moderate and high cognitive ability Home Economic students in HEAT when exposed to cognitive acceleration training programme?

Table-3. Mean achievement and standard deviation of low, moderate and high cognitive ability home economics students in heat when exposed to cognitive acceleration training programme.

Cognitive ability classification		Pre-HEAT	Post-HEAT	Mean gain
Low cognitive ability	Mean	31.43	51.76	20.33
	N	79	79	
	Std. deviation	7.64	10.67	
Moderate cognitive ability	Mean	42.58	61.56	18.97
	N	77	77	
	Std. deviation	7.21	10.00	
High cognitive ability	Mean	52.46	70.23	17.78
	N	59	59	
	Std. deviation	6.75	8.57	

Source: Field survey, 2018.

Table 3 shows that the low cognitive ability students had mean gains of 20.33; the moderate cognitive ability students had 18.97, while the high cognitive ability students had 17.78. This indicates that the gain of the low cognitive ability students is higher followed by the moderate cognitive ability students then the high cognitive ability students. This reveals that students with low cognitive ability improved more than the moderate and high cognitive ability students when subjected to cognitive acceleration training programme.

8.4. Hypothesis 1

There is no significant difference in the mean score of students in Home Economics measure of cognitive ability between those exposed to cognitive acceleration training programme and those taught Home Economics using conventional strategy only.

Table-4. ANCOVA result of difference in the measure of home economics students cognitive ability of those exposed to catp and those exposed to the conventional strategy only.

Source	Type III sum of squares	df	Mean square	F	Sig.
Corrected model	45193.784[a]	2	22596.892	561.029	.000
Intercept	13879.954	1	13879.954	344.608	.000
Pre-ACER	24380.029	1	24380.029	605.301	.000
Group	21374.639	1	21374.639	530.684	.000
Error	15265.192	379	40.278		
Total	1093075.000	382			
Corrected total	60458.976	381			

a. R Squared = .748 (Adjusted R squared = .746)

Source: Field survey, 2018.

Table 4 shows that the ANCOVA result is significant [f(1,379)=530.684 and P=0.00 < 0.05 for group. Since the significant value P=0.00 is less than 0.05 level of significant, the null hypothesis is rejected. This means that there is a significance difference in the measure of Home Economics students' cognitive ability when exposed to CATP.

8.5. Hypothesis 2

There is no significant difference in the mean gains in cognitive ability scores among low, moderate and high cognitive ability level students' exposed to cognitive acceleration training programme.

Table-5. ANCOVA result of difference in the mean gain scores of low, moderate and high cognitive ability students exposed to cognitive acceleration training programme.

Source	Type III sum of squares	df	Mean square	F	Sig.
Corrected model	11228.542[a]	3	3742.847	88.564	.000
Intercept	4670.061	1	4670.061	110.504	.000
Pre-ACER	988.450	1	988.450	23.389	.000
Cognitive ability	251.827	2	125.913	2.979	.053
Error	8917.206	211	42.262		
Total	755871.000	215			
Corrected total	20145.749	214			

a. R Squared = .557 (Adjusted R squared = .551).

Source: Field survey, 2018.

Table 5 reveals that F (2,211)=2.975 for cognitive ability with P=.053≥ 0.05, it shows that there is significant difference in the mean gains of low, moderate and high cognitive ability students. The null hypothesis was, thus, not rejected. This implies that cognitive gain differences among the three ability levels are statistically significant.

8.6. Hypothesis 3

There is no significant difference in the mean achievement scores of low, moderate and high ability level students exposed to cognitive acceleration training programme. There is no significant difference in the mean achievement scores of low, moderate and high ability level students exposed to cognitive acceleration training programme.

Table-6. ANCOVA result of mean achievement score of low, moderate and high ability level students exposed to cognitive acceleration training programme.

Source	Type III sum of squares	df	Mean square	F	Sig.
Corrected model	14355.883[a]	3	4785.294	55.783	.000
Intercept	10057.816	1	10057.816	117.246	.000
Pre-HEAT	2645.765	1	2645.765	30.842	.000
Cognitive ability	984.266	2	492.133	5.737	.004
Error	18100.331	211	85.784		
Total	815241.000	215			
Corrected total	32456.214	214			

a. R Squared = .442 (Adjusted R squared = .434).

Source: Field survey, 2018.

Table 6 reveals that the difference in the mean achievement score of low, moderate and high ability level students is significant, F (2,211) =5.737, P=0.004. Since P=0.004 < 0.05, it means that the null hypothesis is rejected. This implies that students with different ability levels did not achieve equally when exposed to CATP.

9. DISCUSSION

This study reveals that the mean achievement scores of students in experimental group were higher than those in the control group and were statistically significant. This implied that students who were exposed to CATP in addition to the conventional method of teaching performed better than those taught using only conventional method of teaching. The performance of the student could be as a result of the exposure of the students to CATP which increased their level of thinking (cognitive ability) which further enhanced their performance. This finding is in agreement with the findings of Oliver and Grady (2014) who found that thinking science intervention improved

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all participating students' cognition significantly. Oliver *et al*. (2012) also found out that the general ability of the students who participated in the intervention programme improved as they have demonstrated cognitive gains, when compared to similar schools not exposed to the intervention programme. Greater improvement in state wide tests in science, high mean scores by the students exposed to CATP could be as a result of the activities which led to students' improved thinking ability. In studying the relationship between cognitive ability and academic achievement, this present study reveals that the performance of students in Home Economics was determined by the students' level of cognitive ability. This is evident in the performance of Home Economics after the students' were exposed to Cognitive Acceleration Training Programme (CATP) which gave rise to improved cognitive ability. This led to the enhancement of their intellectual capabilities resulting in improved performance in Home Economics. Kyttälä and Lehto (2008); Strenze (2008) and Taub *et al*. (2008) earlier reported that cognitive ability is the most important predictor of achievement in many academic subjects including mathematics. Walberg as cited in Phillipson and Phillipson (2011) computed on average correlation of 0.071 between various tests of intelligence and academic achievement, suggesting that 50% of the variability in scores on academic achievement can be attributed to the level of cognitive ability. Furthermore, cognitive ability is a strong predictor of success in life, including later educational achievement and income (Strenze, 2008). The finding of this study was that there was a difference in the mean gain of students with low, moderate and high cognitive ability exposed to CATP. The result indicated that students of low cognitive ability exposed to CATP gained more than those in the other groups. It was found in this study that the low and moderate cognitive ability group benefited more than the high cognitive ability group. This could be as a result of the fact that students with high cognitive ability are already intelligent so that programme might not be all that beneficial to them but might be more beneficial to the low and moderate cognitive ability students because, it uplifted their cognitive ability by improving their mental imagery, thinking reasoning, problem-solving and general mental development which is the hall mark of cognitive acceleration training programme (CATP). Thus the increase in performance could be a result of the interactive and exciting nature of the programme. Although the difference in the achievement of low moderate and high cognitive ability students is not significant the low students tend to benefit more hence it has increased their thinking capability from what it used to be. The finding of this study is in line with Chandler and Sweller (2012) where it was found that effective use of instructional materials facilitated learning by directing resources activities. Musa (2017) discovered that students who were exposed to motivation enhanced activity based learning achieve more in physics than their counterparts in the control group. In the present study the activities embedded in CATP must have accelerated the learner's cognitive ability thereby enhancing their intellectual capabilities.

10. CONCLUSION

It was concluded from the findings that students' achievement in Home Economics was greatly influenced by CATP and it was significantly higher than their counterparts who were exposed to only the conventional method of teaching Home Economics. The results of this study provided empirical evidence that the use of CATP enhanced the students' cognitive ability and also increased their achievement in Home Economics as revealed by the improved scores.

11. RECOMMENDATIONS

Based on the findings of the study, the following recommendations were made:

1. Cognitive acceleration training programme should be introduced into the upper Basic school curriculum so as to uplift students' cognitive ability which could in turn elevate their academic performance.

2. In-service training, seminar, workshops and symposia should be organized by the state and Federal Ministry of Education for training teachers on the use of cognitive acceleration training programme in teaching their subjects.

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Appendix A

Kogi East students' performance in JSE III home economics between 2005 and 2014.

Year	No. who sat for examination	No. who passed (Grade 1-6)	% Pass (Grade 1-6)
2005	4372	2213	50
2006	4372	1332	35
2007	4231	3110	73
2008	4231	2724	64
2009	3871	2662	69
2010	3871	2135	55
2011	3341	2147	64
2012	3341	2245	67
2013	3121	1325	42
2014	3121	1922	61
Average			**58%**

Source: Ministry of Education Lokoja (2008).