EFFECTS OF COGNITIVE ASSESSMENT SYSTEM TASKS ON PERFORMANCE OF LOW ACHIEVING CHILDREN WITH HEARING IMPAIRMENT IN BASIC MATHEMATICS OPERATIONS IN JOS METROPOLIS, NIGERIA

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ABSTRACT
The study investigated the effects of cognitive assessment system tasks on performance of low achieving children with hearing impairment in basic mathematics operations in Jos Metropolis, Nigeria. It identified three objectives, three research questions and three hypotheses. The study adopted a true experimental research, specifically, the pretest-posttest group design. The population was made up 26 children with hearing impairment with low achievement mean scores in basic Mathematics operations in primary six in Plateau State School for the Deaf, with a sample of twenty (20) low achieving children with hearing impairment in basic mathematics operations participated in the study. Two instruments were used for data collection namely Cognitive Rating Scale for Children with Hearing Impairment (CRSCHI) and Teacher’s Made Test for Children with Hearing Impairment (TMTCHI). T-test for independent sample using the Statistical Package for Social Sciences (SPSS) version 17.0 was used. Three hypotheses were tested at 0.05 levels of significance. The study revealed that CAST improved the cognitive skills of children with hearing impairment, children with hearing impairment performance in basic mathematics operations were also improved after intervention. This showed that CAST is an effective remediation strategy that teachers could use to enhance cognitive profile and performance of low achieving children with hearing impairment in basic mathematics operations. The implications are that CAST enable low achieving children with hearing impairment in primary schools to develop cognitive skills that manifest itself in an imperfect ability to listen, think, and do basic mathematics operations. Therefore, teachers should be trained in the application of CAST to meet the needs of children with hearing impairment in inclusive or special classrooms. This is because CAST can be used in closing the existing gap of persistent poor academic performance of children with hearing impairment.

KEYWORDS: Cognitive assessment, System tasks, Cognitive profile, Performance, Hearing impairment

INTRODUCTION
This study focused on investigating into the effects of cognitive assessment system tasks (CAST) on basic mathematics performance of low achieving children with hearing...
impairment in Bassa, Plateau State. Variation in performance of children with hearing impairment in mathematics is a common phenomenon. Globally, studies on performance of children with hearing impairment mathematics revealed that performance discrepancy significantly exist among them. The core of these variations according to American Speech and Hearing Association (ASHA), (2015) centred primarily on the type of cognitive tasks used by these separate groups and children with hearing impairment tend to have slower learning processes because they cannot pickup various concepts and vocabulary incidentally like children who do not have a hearing impairment. This can be problematic in mathematics classroom.

National Council of Teachers of Mathematics (NCTM) (2000) reported that school mathematics of the twenty first century is viewed by educators to be that which should engage a learner in problem solving and reasoning. It also fosters deep understanding and develops the learners’ critical and analytical thinking. Mathematics refers to the study of numbers and their relationships to time, space, volume and geometric. Sub-skills related to mathematics include addition, subtraction, division, multiplication, among others. These are referred to as the basic mathematics operations. Indeed, mathematics boosts self-esteem, improves quality of life and generally enables the children control circumstances in life.

Children with hearing impairment having difficulties in mathematics cannot be attributed to low intelligence, sensory deficits or economic deprivation but as a result of mathematical calculation and reasoning (application). A study conducted by Mutai (2016) captured low performance profile in mathematics test for both calculations and applied problems among children with hearing impairment. The report indicated that children with hearing impairment were 3.0 grades below on test of mathematics. That is about 90% of children with hearing impairment scored below the median, while just less than 10% of children with hearing impairment achieved at grade level on the test of mathematics problem solving. Performance in mathematics skills is a product of early cognitive development.

Many of the children lack basic numeracy skill and could not carryout simple mathematics operations such as addition and subtraction. At the secondary school level, the situation is not any better. To enhance the performance of children with hearing impairment in mathematics, Cognitive Assessment System Tasks (CAST) was designed with the view to improving both cognitive skills and academic performance of children with hearing impairment. CAST is geared towards improving thinking and academic performance through a comprehensive and targeted set of learning materials. Intervention on cognitive deficiencies. Admittedly, Arihin and Offoe (2015) contended that CAST contains series of challenging
problem solving tasks and exercises in specific areas of cognitive development such as: projecting, relationship, orientation in space, classification, temporal relations, hierarchical relations and transitive relations. It is against this background information and the existing gaps that this study intends to carry out a systematic investigation into the effects of CAST on the performance of low achieving children with hearing impairment in mathematics in Jos metropolis.

**STATEMENT OF THE PROBLEM**

The underachievement of children with hearing impairment is well documented and, despite the recent technological advances, including the advent of hearing screening, too many children with hearing impairment are still leaving school with mathematical attainment considerably low. Research continues to show that there is enormous variation in mathematics achievements of children with hearing impairment. Such children have trouble understanding verbal and written mathematics problem because they might not be able to pick up new vocabulary and concept without being directly thought. These children do not have the basic mathematics vocabulary needed to fully understand verbal and written mathematics problem and understanding mathematics concepts and processes.

There is also abundant evidence that children with hearing impairment lack basic numeracy skill and therefore are unable to carry out simple mathematics computation such as addition, subtraction, multiplication and division among others. The issue of gender as it affects the performance of children with hearing impairment in basic mathematics has not been established whether or not variations exist. Hence, the fundamental problem of this study is that the performance of children with hearing impairment in basic mathematics operations remain below average.

**AIM AND OBJECTIVES OF THE STUDY**

The purpose of this study was to examine the effects of cognitive assessment system tasks on performance of low achieving children with hearing impairment in basic mathematics operations in Jos metropolis, Nigeria. The specific objectives of the study are to:

1. determine the cognitive profile of low achieving children with hearing impairment.
2. find out the differences in the performance of children with hearing impairment in basic mathematics operations (addition, subtraction, multiplication and division) before and after exposure to the CAST.
3. ascertain the difference in the performance of male and female children with hearing impairment in basic mathematics operations (addition, subtraction, multiplication and division) before and after exposure to the CAST.
RESEARCH QUESTIONS

In light of the problems raised in the study, the following research questions were postulated:

1. What is the nature of performance of children with hearing impairment in basic mathematics operations (addition, subtraction, multiplication and division) before exposure to CAST?
2. What will be the performance mean scores of basic mathematics operations of children with hearing impairment exposed to CAST and those not exposed?
3. What will be the performance mean scores of male and female children with hearing impairment in basic mathematics operations before exposure to CAST?

HYPOTHESES

The following null hypotheses are stated and shall be tested at 0.05 level of significance:

1. There is no significant difference between the mathematics test mean scores of children with hearing impairment in experimental and control groups before and after intervention.
2. There is no significant difference between the basic mathematics operations mean scores performance of children with hearing impairment exposed to CAST and those not exposed.
3. There is no significant difference between the basic mathematics operations mean scores performance of male and female children with hearing impairment exposed to CAST.

THEORETICAL/CONCEPTUAL FRAMEWORK

The CAST can be adapted to help children build skills in problem-solving slowly from their physical experience with real work. Their intuition, logic and visual skills are harnessed in the process. They are able to build from their poor knowledge problem solving skills in a way that is meaningful to them. In acquiring the intuition for perceiving the essence of a word problem, the foundations for higher level mathematical skills are likely built. Besides, ability to symbolize, represents, and generalize mode are enhanced.

METHODOLOGY

The pretest/posttest true experimental research design was used for this study. This is because the study intended to find out whether or not the participants could be affected by Cognitive Assessment System Tasks (CAST) treatment. The population for the study was made up of all 26 children with hearing impairment in Primary Six comprising 16 males and 10 females in Plateau School for the Deaf, Bassa. A sample of 20 low achieving children with
hearing impairment in mathematics operations participated in this study. This figure comprised of 13 male and 7 female respondents. All children with hearing impairment audiogram showed a bilateral hearing loss, ranging from severe to profound as defined by the International Standard Organization (ISO) and the American National Standard Institute (ANSI). The nature of the hearing impairment was sensori-neural ranging from (70-90+dB) (Decibel). The respondents were also pre-lingual children with hearing impairment which means that the hearing loss occurred between birth and prior to acquisition of societal language.

Purposive sampling technique was adopted in selecting the sample for the study. The technique was deemed appropriate because the sample possessed specific characteristics to be studied. The characteristics included children with hearing impairment with persistent low achievement scores in mathematics.

Two instruments were used for this study namely, Cognitive Rating Scale for Children with Hearing Impairment (CRSCHI) and teacher made Basic Mathematics Test for Children with Hearing Impairment (BMTCHI). Inferential statistics such as t-test was used and decision was determined at 0.05 level of significance.

RESULTS

Hypothesis One: There is no significant difference between the mathematics test mean scores of children with hearing impairment in experimental and control groups before and after intervention.

Table 1: Summary of t-test Analysis of the Differences in the Mathematics Test Mean Scores of CWHI in Experimental and Control Groups after Intervention

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>(\bar{x})</th>
<th>SD</th>
<th>Df</th>
<th>t-cal.</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>10</td>
<td>55.00</td>
<td>7.07</td>
<td></td>
<td>11.196</td>
<td>0.00</td>
</tr>
<tr>
<td>Control</td>
<td>10</td>
<td>24.00</td>
<td>5.16</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P < 0.05

Table 1 showed the analysis of mathematics test mean scores of children with hearing impairment in experimental and control groups after intervention. The SPSS output showed that experimental group had a mean score of 55.00 with a standard deviation of 7.07 whereas the control group has a mean score of 24.00 with a standard deviation of 5.16. This indicated that there is a significant difference in the mathematics test mean scores of children with hearing impairment in experimental and control groups after intervention. In addition, the calculated value of t was 11.20 while the P-value was 0.00. Since the P-value was less than 0.05, it meant that there is less than 1% chance that the difference between the mathematics test mean scores of children with hearing impairment in experimental and control groups after
intervention occurred by chance. Therefore, the null hypothesis was rejected and concluded that there is a significant difference between the mathematics test mean scores of children with hearing impairment in experimental and control groups after intervention.

**Hypothesis Two:** There is no significant difference between the basic mathematics operations mean scores performance of children with hearing impairment exposed to CAST and those not exposed.

**Table 2: Summary of t-test Analysis of the Differences in the Basic Mathematics Operations Mean Scores Performance of CWHI Exposed to CAST and those not Exposed**

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>$\bar{x}$</th>
<th>SD</th>
<th>Df</th>
<th>t-cal.</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Experimental</td>
<td>10</td>
<td>59.50</td>
<td>7.80</td>
<td>18</td>
<td>10.026</td>
<td>0.00</td>
</tr>
<tr>
<td>Control</td>
<td>10</td>
<td>26.50</td>
<td>6.89</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P < 0.05

Table 2 revealed the analysis of basic mathematics operation mean scores performance of children with hearing impairment exposed to CAST and those not exposed. The SPSS output showed that the experimental group has a mean score of 59.50 with a standard deviation of 7.80 whereas the control group had a mean score of 26.50 with a standard deviation of 6.89. This showed that there is a significant difference in the basic mathematics operation mean scores performance of children with hearing impairment exposed to CAST and those not exposed. Therefore, the alternative hypothesis is accepted and concluded that there is a significant difference between the basic mathematics operations mean scores performance of children with hearing impairment exposed to CAST and those not exposed.

**Hypothesis Three:** There is no significant difference between the basic mathematics operations mean scores performance of male and female children with hearing impairment exposed to CAST.

**Table 3: Summary of t-test Analysis of the Cognitive Functioning Level of Male and Female CWHI Exposed to CAST**

<table>
<thead>
<tr>
<th>Group</th>
<th>N</th>
<th>$\bar{x}$</th>
<th>SD</th>
<th>Df</th>
<th>t-cal.</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male</td>
<td>5</td>
<td>2.00</td>
<td>0.71</td>
<td>8</td>
<td>-0.408</td>
<td>.694</td>
</tr>
<tr>
<td>Female</td>
<td>5</td>
<td>2.20</td>
<td>0.84</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

P > 0.05

Table 3 revealed the analysis of cognitive functioning level of male and female children with hearing impairment exposed to CAST in experimental group. The SPSS output showed that the male had a mean score of 2.00, a standard deviation of 0.71 whereas the female has a
mean score of 2.20 and a standard deviation of 0.84. This showed that there is no significant difference between the cognitive functioning level of male and female children with hearing impairment exposed to CAST. In addition, the calculated value of t was -0.41 while the P-value was 0.694. Since the P-value was greater than 0.05, it meant that there was greater than 69.4% chance that the difference between the cognitive functioning level of male and female children with hearing impairment exposed to CAST occurred by chance. Therefore, the null hypothesis is upheld and concluded that there is no significant difference between the cognitive functioning level of male and female children with hearing impairment exposed to CAST.

FINDINGS OF THE STUDY
Based on the analysis of results, the following findings were made:

1. The study established that the cognitive profile of low achieving children with hearing impairment is attributed to the presence of severe to profound cognitive processing deficit. This was because the numbers of responses classified as severe to profound cognitive deficit were very high.

2. It was found that the slow development of cognitive skills among children with hearing impairment was the impediment to their low performance in basic mathematics operations.

3. Findings further indicated that CAST enhanced cognitive skills and performance of children with hearing impairment after intervention compared to those not exposed. This further confirmed the fact that CAST can be used to effectively enhance logic and reasoning skills of children with hearing impairment.

4. The findings further revealed that low achieving children with hearing impairment in basic mathematics operations exposed to CAST out performed those not exposed. This is because children with hearing impairment recorded significant improvement in cognitive skills. In effect, their performance in basic mathematics operations improved.

5. There was no significant mean difference in the performance of male and female children with hearing impairment in cognitive development skills and basic mathematics operations after exposure to CAST. Their cognitive skills and performance in basic mathematics operations were above average after intervention.

DISCUSSION
Based on analysis on Table 2, the pretest and posttest mean scores of basic mathematics operations skills of children with hearing impairment in experimental group is 26.25 and 59.50 while 27.00 and 27.00 was recorded for the control group pretest and posttest mean scores respectively. The analysis may be interpreted to mean that there was no improvement in the
performance of children with hearing impairment in the control group before and after intervention while a significant improvement was recorded for children in the experimental group after exposure to CAST. Therefore, it is concluded that there was a significant difference between the basic mathematics operations mean scores performance of children with hearing impairment exposed to CAST and those not exposed. The null hypothesis is therefore rejected.

CAST therefore has the potential to effectively remediate deficiencies in cognitive tasks capable of enhancing higher academic performance. This means that since the cognitive skills of children with hearing impairment has been enhanced after exposure to CAST, their performance in mathematics is bound to be improved. This is because the deficiency of children with hearing impairment is a product of lack of insufficiency of mediated learning environment and is responsible for and reflected in retarded cognitive performance. Hence, CAST is intended to correct and developed those functions that because of their deficient nature, are responsible for retarded performance. More so, CAST provides information relevant for school learning tasks. Mathematics concept and concepts are introduced in the context of real-world situations, there are graded discovery exercises that children are encouraged to explore on their own that helps to integrate mathematical concept as well as knowledge of other subjects. This result suggested that the difficulty may be attributed to either lack of mathematical literacy or have fewer opportunities to learn or are less able than other children to learn the culturally transmitted aspect of mathematical knowledge or all of the above.

In testing hypothesis three, the study outcome revealed that in the pretest cumulative mean scores performance of both male and female children with hearing impairment was below average but after exposure to CAST, both male and female improved above the average level. It is therefore concluded that there is a significant different in the mean scores performance in basic mathematics operations of male and female children with hearing impairment after exposure to CAST. Hence, the null hypothesis is rejected.

This finding is in consonant with the study of Mutai (2016) who stated that gender was strongly associated with mathematics achievement with the boys outperforming the girls. Similarly, Arhin and Offoe (2015) further confirmed the above finding by reporting that male children performed better than the female in mathematics achievement. This is because boys have a stronger affinity and interest towards mathematics than the girls. The variations in the performance are attributed to brain lateralization which is used to explain cognitive differences which are in favour of boys’ achievement in mathematics. The explanation given has been that the right hemisphere which controls spatial related activities develops earlier in boys than girls. Hence, a person with greater competence in spatial related activities is likely to perform well
in science and mathematics. This explains why boys are more likely to be good in science and mathematics compared to girls. In line with the findings, the issue of gender led to two conclusions: the average gender gap is very small (statistically not significant). The researcher’s experience revealed that girls showed higher level of mathematics anxiety than the boys which have negative consequences for their later mathematics education. However, the results of schools and public examinations in mathematics continue to show declining capacity of children with hearing impairment. The implication of this finding is that since the differences in ability of male and female children with hearing impairment in mathematics may not necessarily be genetic, CAST can be used to narrow the gap.

CONCLUSION

The study observed that children with hearing impairment (CWHI) had not adequately mastered cognitive tasks that are necessary pre-conditions for development of other aspects of academic achievement. Lack of these skills had contributed immensely to their consistent mass failure in basic mathematics operations and other school subjects. Similarly, memory, reasoning and recall skills of children with hearing impairment were assessed and deficiencies were identified in sequential memory, processing speed, attention and memory load that are important to learning. These skills which are prerequisite to higher performance in basic mathematics operations are lacking.

It can therefore, be concluded that CAST positively enhanced the cognitive development of children with hearing impairment in which their memory recall skills, logic and reasoning skills as well as their performance in basic mathematics operations significantly improved. Taken together, the findings of this study, has revealed that children with hearing impairment in Nigeria, through these cognitive enhancement skills, can now be expected to benefit more meaningfully in basic mathematics operations.

RECOMMENDATIONS

On the basis of the findings of this study, the following recommendations are made:

1. The Nigeria government and service providers should adopt (CAST) as a cognitive tasks for developing cognitive skills of children with hearing impairment. This is because CAST gave access to children with hearing impairment to develop higher cognitive profile, enhancement of memory recall skills, logic and reasoning skills as well as improvement in academic performance. Thereby unlocking the curriculum contents. Through such a novel idea in education of children with learning impairment, they will get easy access to the curriculum contents.
2. CAST strategy should be utilized in teaching low achieving children with hearing impairment in basic mathematics operations and other school subjects generally. This should be used simultaneously with sign language, auditory training and speech/lip reading as rudimentary skills that all children with hearing impairment need to undertake to cope in inclusive or special classrooms.

3. To improve teachers’ quality there is bound to be a regular in-service training in cooperating modern teaching techniques, new ideas, new curriculum and make them to be positively disposed to their work. These positive impacts on the teachers would definitely have a corresponding impact on the children’s academic performance. Therefore, teachers should be trained in the application of cognitive tasks to meet the needs of children with hearing impairment in inclusive or special classrooms. This is because CAST be used in closing the existing gap of persistent poor academic performance of children with hearing impairment.

4. Parents/guardians of children with hearing impairment should be encouraged by school administrators to use CAST to initiate early cognitive development tasks as an essential predictor of higher mathematics operations. With such involvement, the impediments against academic performance of children with hearing impairment will be minimized.

CONTRIBUTION TO KNOWLEDGE

It is obvious that the study has contributed immensely to knowledge. First, CAST is an effective strategy in unlocking cognitive delay experienced by children with hearing impairment cumulating in their consistent mass failure in basic mathematics to higher achievers. Secondly, if low achieving children with hearing impairment are exposed to proper cognitive tasks, they will be able to solve mathematics problems appropriately. Therefore, the programmes of activities designed in this study have the potential of predicting higher achievement when utilized.

REFERENCES

