

## Revalidation of Conservation of Pre-Operational Stage of Piaget's Cognitive Theory using Mental Characteristics in Mayo-Belwa Local Government Area, Adamawa State, Nigeria

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### Abstract

The purpose of this study was to determine the extent to which children between the ages of 2-7 in Mayo-belwa Local Government Area of Adamawa state exhibit the mental characteristics of pre-operational stage of Piaget's theory of mental development. A sample of 576 nursery and primary school pupils and unschooled children between the ages of 2-7 were selected using quota and purposive sampling techniques. One research question and one hypothesis were formulated to guide the study. An instrument titled 'Piaget's Experimental Procedures and Interview Battery (PEPIB)' was used to collect data. The instrument was subjected to face and content validation. The reliability an index of 0.73 was obtained. This values was high enough to permit investigation. Descriptive statistics of frequency lines and percentage was used to answer the research question while a two sample Kolmogorov Smirnov test was used to test the hypothesis. The results revealed that children between the ages of 2-7 in Mayo-belwa Local Government area of Adamawa state exhibited all the mental characteristics of pre-operational stage of Piaget's cognitive theory. There were significant differences in performance on conservation of number, mass, length, liquid, weight and volume between boys and girls at the pre-operational stage of mental development. It was therefore concluded that the theory can be used with confidence in non-western environments.. The issues raised by the study were also examined from the perspective of counselling and human development practice. It was recommended among other things that Counsellors be massively trained and posted to work in all UBE schools so as to diagnose and treat children's developmental problems at the various stages of growth and development. Periodic training workshops should be organized for elementary school teachers to understand how children think and learn.

**Key words:** Counselling and Human Development, Pre-operational, Conservation, Pre-operational thinkers

### Introduction

The researcher's interest to carry out this study arose from involvement in the preparation for and supervision of teaching observation and practice-teaching of student-teachers in nursery and primary schools in Adamawa state's 21 Local Governments. It was while doing supervision of these student teachers that his interest on cognitive development was further kindled. Most of the students preferred to teach in the upper classes of the primary than to be posted to lower classes and nursery section. On being questioned for their preference, they explained that nursery school pupils and lower classes in the primary schools were difficult to teach mathematics because of their poor reasoning and intellectual growth. The researcher supervised a student-teacher in one of the rural schools in Mayo Belwa Local Government. The topic set for primary two pupils between the ages of 7-10 was simple addition and

subtraction that required finding the missing link. The intellectual tasks were the following:

$$15 + \square = 30$$

$$10 - \square = 7$$

$$\square + 8 = 20$$

$$\square - 3 = 15$$

Despite the fact that these children know how to count, add and subtract simple numbers, a substantial number of them failed the problems including those that are big enough to be in the upper class of the primary school. It is assumed that the curricular content is based on the cognitive development of children at this level and considering the late entry of pupils to school in the

local government, it is expected that the older pupils are supposed to do better than the young ones. The researcher therefore postulated that something was wrong with children's cognitive development.

It was at this time that the researcher's thought went to Piaget's theory of cognitive development who believes that cognitive development results from the interaction between a person and his physical and social environment. Most of the pupils that come to school do so around the ages of 8-10 when Piaget says that children are supposed to solve basic mental tasks such as Seriation, classification and conservation. If these children were able to conserve the basic properties of number such as addition and subtraction, they would not fail these sums particularly the older pupils. This therefore calls for the need to verify this theory among Nigerian children.

Piaget upholds that cognitive development results from an interaction between a subject and his/her total environment. This may therefore mean that a child who comes from impoverished environment would not be able to perform with success the basic intellectual task relevant to his chronological age as posited by Piaget. This may explain why children in Mayo Belwa do poorly in school work and this strengthens the assumptions that Nigerian children may lag behind European children in performance on Piagetian tasks.

The works of Piaget (1962, 1969, and 1971), Piaget and Inhelder (1973) revealed that he conducted a longitudinal study on his three daughters, Lucienne, Laurent and Jacqueline. The studies found that intellectual development is orderly and sequential and that child's thinking is qualitatively different from that of adult. According to them, all children go through four main stages (sensori-motor, pre-operational, concrete-operational & formal operational) in the evolution of thinking ability which takes a number of years to develop. According to him, children develop in sequence of stages by age from infancy to post adolescence. Each stage of learning is necessary for the development of the stage that follows. A child cannot skip a stage because each stage paves way for the one that follows.

Prior to the development of a particular stage, the child is usually unable to handle the tasks of that stage and any attempt to force the child to learn the

material appropriate to that stage will be unproductive as he does not possess the mental capacity to cope. The sensori-motor stage is therefore characterized by the use of sense organs and certain parts of the body which helps the neonate to survive in the environment.

The pre-operational stage which begins from 2-7 years is characterized by the child's inability to form concepts and perform operational tasks. His thinking is dominated by perceptual centration. Conservation is one of the main features of Piaget's theory at the pre-operational stage. It is the belief by the child that the properties of an object remain the same irrespective of the physical changes in the property of that object. At this stage, children refuse to be convinced that the properties of an object are still the same in spite of the changes in the appearance of the object. They are referred to as no-conservers while those who affirm that they are the same even when physical changes are noticed in the appearance of the object are called Conservers.

Piaget (1957, 1969) describes the concept of conservation (or invariance of substance) when the properties of substances such as lump of plasticine, a collection of beads, length or volume remain permanent in amount independent of the re-arrangement of its individual parts. This means that the properties of an object remain constant even if the physical appearance of an object is changed. It is therefore believed that only the concrete operational thinkers that can successfully perform conservation tasks whereas most pre-operational children find it difficult to perform such tasks. For instance, the adults know that a certain amount of liquid stays the same regardless of the shape of the container. But this is not understood by all young children. Rather, they are struck by the height of the liquid in the container. When two equal amounts of liquids are put in to two differently shaped vessels, he will likely say that one vessel has more liquid than the other.

For instance, studies have shown that when a child is presented with mental or Piagetian tasks such as classification, Seriation, conservation of number, length, volume, substance etc, he finds it difficult to solve them but as soon as he reaches the concrete-operational stage, he is able to carry out the tasks with ease.

The attention of the researcher is drawn to pre-operational stage because of the mental characteristics which are unique for other two stages (sensori-motor and formal-operational stages). The child's ability to think and reason is qualitatively different from those of adults. Piaget believes that children's thinking at these two stages is based on perception rather than reasoning and it is only when he reaches the fourth stage that he thinks like normal adults. According to Thompson (1970), Durojaiye (1979) and Oladele (1987), Piaget did not use large samples to collect relevant data to back up his conclusions about the general pattern of mental development. His use of three children to conduct his longitudinal study sets the stage for further research. The three children were all females and it is known that sex differences lead to different performance on intellectual tasks. For instance, Ehindaro (1980) found out that girls excel in verbal tasks while boys excelled in spatial ability tasks. It is therefore obvious that the performance of western children may differ from those of Nigerian children. There is therefore need for this study to examine sex differences in children's cognitive development

Variations in the ages of attainment of pre-operational and concrete-operational stages have been found by cross-cultural studies such as Abiola (1964, 65), Dasen (1973), Duruji (1980), Fajemidagba (1982), Bidell (1999), Heffner (2003), Gross (2005) and Edwards (2006). These studies reveal that while some children develop at the same rate with European children, others develop earlier than European children, hence the need for this study

Literature consulted showed that Piaget's theory of mental development like most theories in psychology, was developed and trial-tested in Swiss whose cultural values and norms differ from those of the African society. Cross-cultural studies of Ashton (1975) have highlighted the possible effects of culture on cognitive development. The parent-child interaction for instance, is very limited amongst the various ethnic groups in Nigeria. According to Nwachukwu (1978) and Ebenebe (1986) contrast the parent-child interaction pattern between European and African society. They reported that parents in the rural and urban environment hardly have time to talk or answer questions from their inquisitive children. Where a child is seen to be curious or bold to ask a lot of questions, parents are known to discourage him by

asking him to keep quite. On the other hand, in European environment, children are given every opportunity to interact with parents and other significant others in the family environment. Piaget considers this active interaction very crucial to cognitive development. If according to Piaget, cognitive development results from an interaction between a child and his total environment, the researcher speculates that the limited active interaction with the environment may inhibit children's mental characteristics in Mayo-belwa Local Government Council at the designated stages of cognitive development.

Numerous conservation training studies have been carried out in both western and non-western environment to find out whether training would speed up conservation ability in children. The result of these studies have been inconsistent, some reporting success and some reporting failure.(Murray,1976; Nyiti,1977;Philip and Kelly,1978;Fajemidagba,1983; Ebenebe,1986) These studies did not however consider other factors that may be responsible for these conflicting research findings.

In the light of these inconsistencies in research findings, this study attempted to determine the extent to which previous findings on conservation abilities of western children conform to those of Nigerian children

Piaget's theory of cognitive development was developed in western environment. The ideas of this theory are however holistically used to address problems in education in non-western environments without being aware of their limitations

In Mayo Belwa Local government Area, the age of starting formal schooling is 6 years but a large proportion of children particularly in the rural areas start schooling at a much later age. It is therefore not uncommon to find children with age range of 6-11 years in primary one and two who find it difficult to read and write and perform simple numerical problems. This is contrary to Piagetian ideas that children who have attained the ages of 7-8 years should be able to perform classification and conservation tasks (Piaget, 1969). Piaget's theory was developed using three children who were all female subjects. Cross-cultural studies have revealed differences in performance between male and female subjects. It is therefore possible that

children's performance in western environment when compared with children of both sexes in non-western environment may differ.

According to Piaget, cognitive development results from an interaction between a child and his total environment. Studies have shown that children in European environment actively interact more with their environment than children in non-western environment. Performance on Piagetian tasks may be expected to differ significantly between African and European children.

The ideas of Piaget's theory are mostly used in curriculum design and development and classroom teaching. However, problems arising from the use of the theory and how to promote cognitive development have not been considered by previous studies. Information is also lacking on how such problems can be addressed from the perspective of Counselling and Human Development Perspective.

Replication studies on Piaget's theory of mental development were concentrated in the period before independence. Since then, very few but isolated studies have been carried out in both western and non-western environments. It is therefore not conventional to use Piagetian ideas without first subjecting them to careful validation studies in order to update the results of previous studies so as to build more confidence in the use of the theory. As far as the search for literature is concerned, no replication study on Piaget's theory was carried out in Mayo-belwa local government

The purpose of this study therefore is to verify whether the mental characteristics of pre-operational stage of Piaget's theory are exhibited by children between the ages of 2 and 7 in Mayo- Belwa Local Government Area of Adamawa State. Put in question form: To what extent will children between the ages of 2 and 7 years in Mayo- Belwa Local government Area exhibit the conservation abilities of Piaget's pre-operational stage of cognitive development? Piaget did not use large samples to collect relevant data to back up his claims about the general pattern of mental development. The use of three children to conduct his longitudinal study sets the stage for further research. Will this study obtain similar findings using large samples? The three children were all females and it is known that sex differences lead to differences in performance on

intellectual tasks. Will performance on Piagetian tasks between boys and girls differ significantly?

The objectives of the study are to determine:

1. the extent to which conservation abilities of 2-7 year old children in Mayo-belwa Local Government area of Adamawa state conform with Piaget's theory at pre-operational stage.
2. Whether sex influences children's attainment of pre-operational stages of cognitive development

The following research questions will be answered in the study:

1. Do the conservation abilities of 2-7 year old children in Mayo-belwa Local Government Area of Adamawa State conform to Piaget's theory at the pre-operational stage?

### ***Hypothesis***

H<sub>01</sub>: There is no significant difference between boys and girls in performance on conservation tasks at the pre-operational stage of cognitive development.

The primary objective of this study is to determine the extent to which the mental characteristics of 2-7 year old children in Mayo-belwa local Government area of Adamawa state conform to Piaget's theory on pre-operational and concrete-operational stage. The findings of this study will benefit stake holders in the education industry such as Curriculum specialists, Classroom teachers, Measurement experts, Human Development counsellors, School Administrators, Researchers, Pupils, and Universal Basic Education Commission (UBEC)

It would help curriculum developers to develop appropriate curriculum contents that match the level of pupils' cognitive stages of development. Curriculum developers will therefore use the ideas of conservation and classification in developing the primary school mathematics and science curricula so that children gain from learning opportunities provided. This is because the ability to conserve the basic properties of quantity, number, length, volume etc is basic to western education system from which we derive our pattern. The results will also provide curriculum developers with relevant diagnostic information which could form the basis of meaningful revision of the curriculum that will match the intellectual stages of the children.

The result will help Classroom teachers in the choice of relevant instructional objectives and learning experiences that will match pupils' level of intellectual development. Their knowledge on conservation, classification, egocentrism, animism etc will not only expose them to appropriate techniques but make them more effective in teaching and learning particularly in nursery and lower primary classes. When the theory is successfully validated, teachers will therefore use the ideas to improve in their methods of teaching.

Measurement experts, researchers and psychologists who are interested in the study of Piagetian psychology will make use of the findings in carrying out further research. Counselling psychologists will find the work very useful in that they will understand the psychological basis of most of the academic problems confronting children in schools. Possession of in depth knowledge of this theory will arm them with the basic skills needed in the diagnosis and treatment of children's academic problems.

School administrators will find the study useful in their effort to improve children's academic performance by providing conducive school learning environment.

Pupils will also benefit from this study because they will understand the subjects taught by teachers who make use of the ideas of Piaget's theory of cognitive development.

The study will assist the Universal Basic Education Commission particularly the Inspectorate Division in effective supervision of teachers and drawing good recommendations to the ministry of Education on staff development and provision of conducive learning environment

This study delimited to private nursery and public primary school children in Mayo- belwa Local Government Area of Adamawa State. The study will cover Nursery and Primary school children between the ages of 2 and 7. The study is also delimited to the study of the mental characteristics such as conservation of number, length, weight, volume and substance at the pre-operational stage of Piaget's theory of cognitive development.

A cursory look at the literature reviewed in this study shows that most of the works cited are outdated publications which however provides

fertile grounds for further research. The use of some obsolete citations is therefore one of the limitations imposed on this research.

### **Materials and Methods**

The research design that is appropriate to this study is survey design. According to Gay (1996), a survey design is an important attempt to collect data from members of the population in order to determine the current status of that population with respect to one or more variables. Survey research, according to Busha and Harter (1986) is characterized by the selection of random sample from a large and small population to obtain empirical knowledge of contemporary nature. This knowledge allows generalization to be made about characteristics, opinions, beliefs and attitude of the entire population being studied. Hassan (1995), Ofo (1994) & Oche (2007) see survey design as a research that involves direct contact with a population or sample that has similar characteristics which are relevant to specific investigation. The choice of this design was based on the fact that it enabled the researcher to determine the presence or absence of the attributes to be measured through interview and simple experiments.

This study was based on Simple experiments. Simple experiments were used in the past by Psychologists including Piaget in an attempt to study human behaviour. The survey design therefore used simple experiments and interview schedules to collect data from the target population. Like Piaget, a simple experimental set up such as a quiet office in the school was used. The study involved carrying out experiments with the selected children using Piaget's simple experimental procedure. The experimental apparatus were arranged on a large table according to the order of the tasks to be administered. Each variable to be tested has its own experimental procedures adapted from Piaget's work which was followed by the researcher in conducting the experiment.

### **Population and Sample**

The population of this study consisted of all pupils between the ages of 2-7 in primary schools in Mayo- belwa local government Area. There are 125 public primary schools with an estimated population of four thousand school pupils. Since simple experimental procedures were used to generate data, the researcher was not bound by the use of large samples in survey research. This is because conducting experimental study is time consuming,

which takes at least 30 minutes to treat a subject. A total of 576 pupils (288 boys, 288 girls) were drawn from the population, Ninety-six pupils for each age level were selected for the study. In order to ensure homogeneity and comparability among the data yielding subjects, equal number of subjects was maintained in the selection. A list of pupils between the ages of 2 and 7 was taken from school records and used to carry out the experiments. The subjects were selected from the list using hat and draw method of random sampling

### ***Research Instrument***

The Instrument titled 'Piaget's Experimental Procedures and Interview Battery' (PEPIB) was developed by the researcher. The researcher, during the process of reading and searching for relevant information, gathered and listed the characteristics of the pre-operational and concrete-operational stages of mental development from Smith, 1992, 96; Sternberg, 1998; Presnel, 1999; Bidell, 1999; Santrock, 2001; Gross, 2005; Colson, 2006; Edarwds, 2006; and Skylar, 2010). The studies of Piaget (1951, 52), Khan and Garrison (1973), Philip and Kelly (1978), Serafine (1988) and Santrock (2001) to mention a few, also provided information on the apparatus and experimental procedures which were adapted for use.

This instrument is divided into two parts: Part A contains the biographical data such as sex, and class while Part B which contains the experimental procedures used for the experiments has eight (8) sections. Each section contains simple experimental procedures which measure children's performance on a particular Piagetian attribute such as Classification and class inclusion ability, Seriation, conservation of number, substance, length, liquid, weight and volume tasks. The items were at this stage presented to specialists in instrument development. These are university lecturers in the area of Educational Psychology, Counselling and Educational Measurement. These Lecturers were requested via a letter to critically examine the relevance of the items in each section, the simplicity of expression, double-barrelled statements, clarity of items, statement of facts, vagueness of statements and any other relevant considerations to the instrument. Based on the recommendations of the Validators, some items were deleted while others were re-arranged and a final instrument called '**Piaget's Experimental Procedures and Interview Battery (PEPIB)**' was developed. The

researcher carried out a pilot study preliminary to the major study. It was carried out in Poli Academy, Kofare, in Yola South Local Council

### ***Reliability of the instrument***

The measure of stability was obtained from a sample of 100 children (50 boys and 50 girls) who were not part of the target population. Cronbach's alpha was used to compute the reliability indices of the instrument. This yielded a coefficient of 0.73. This value is considered high enough to conduct the study.

### ***Procedure for Data Collection***

The instrument was administered by the researcher to all subjects in each of the schools selected for the study. It was done individually in a quiet office under permissive, game-like and untimed conditions. As the child entered the room, he or she was asked to supply information about him or herself such as name, age, class and date of birth. The aim was to confirm that the child's name was on the list of the pupils selected for the study. The tasks were administered in accordance with the instructions and order in which they were presented in the instrument.

The experimental procedure which consists of probing the subjects' ability to perform through flexible interrogation was used. Questions and instructions were repeated where necessary. Each task began with an orientation session. The researcher recorded the subject's response and performance as he or she moved from one task to another

The duration of the interview was flexible which ranged between five to ten minutes. At the end of the experiments, the child was thanked and given some sweets and asked to go back to the class. He or she was also given the name of the next child to call for the researcher.

The researcher also reached out to unschooled children through Tsangya schools, Sunday schools and Christian Women's Fellowship meetings. This procedure applied only to this group of subjects. The names of the subjects were compiled according to age and sex.

### ***Method of Data Analysis***

The purpose of this study was to determine whether or not children between the ages of 2 and 7 exhibit the mental characteristics of Piaget’s pre-operational stage of mental development. The use of descriptive statistics such as frequency counts and percentages to answer the research question posed was therefore considered to be most appropriate.

Hypothesis 1 was tested using a two-sample Kolmogorov Smirnov Test. Kolmogorov Smirnov test is a widely used non-parametric statistical test. It is concerned with the agreement between two sets of sample values of two cumulative distributions. If the two samples are drawn from the same populations, the cumulative frequency distributions of both samples are expected to be close to each other and the null hypotheses are expected to be accepted. If the deviation between the two sample cumulative distributions is large, the hypotheses are

expected to be rejected. The use of this test is most appropriate to this study because according to Adoniscrik (2001) and Oche (2006), it is more powerful than the Chi-square goodness of fit test because the numerical values are not affected by the size of the sample

**Results**

*Research Question 1: Do the mental characteristics of 2-7 year old children in Mayo-belwa Local Government Area of Adamawa State conform to Piaget’s theory on pre-operational stage?*

The results of the analysis of mental characteristics such as conservation of number, mass, length, liquid, weight, volume etc are presented in Tables 1.6

**Table 1:** Conservation of Number by 2-7 year olds at the pre-operational stage

Age	Conservers		Non-Conservers		Total
	Frequency	Percentage (%)	Frequency	Percentage (%)	
2	2	2.1	94	97.9	100
3	9	9.4	87	90.6	100
4	46	47.9	50	52.1	100
5	37	38.5	59	61.5	100
6	64	66.7	32	33.3	100
7	78	81.3	18	18.8	100
Total	236	100	340	100	

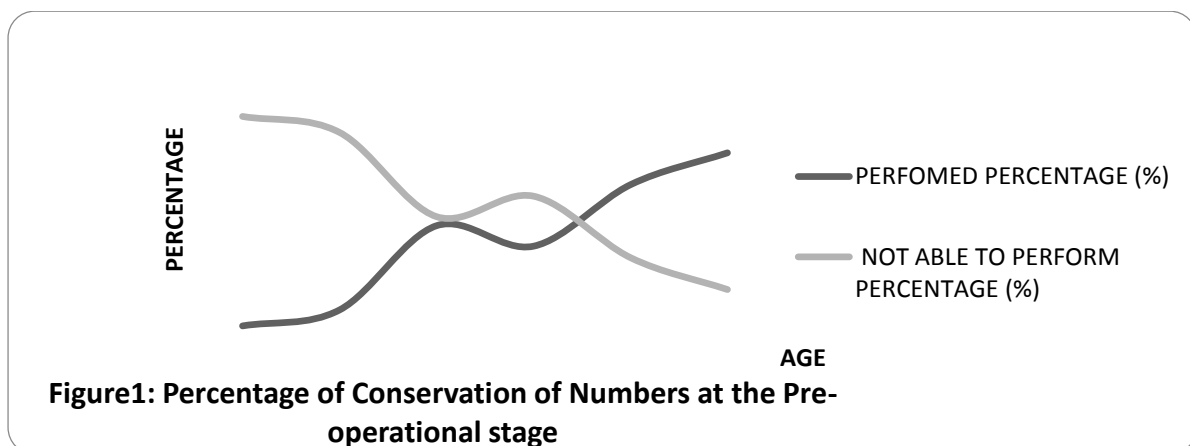


Table 1 shows the results of analysis of children’s perform on conservation of number tasks as postulated by Piaget. Result of the study shows that about 97.9% of 2 year olds find it difficult to carry out conservation of number tasks. This disability is

conquered with increase in age. From this stage, the child’s ability to conserve number increases with age while the proportion of those who could not conserve decreased progressively with increasing age. At the age of 7, only 18.8% of the children

could not conserve while 81.3 % could conserve number successfully. This therefore confirms

Piaget’s views on conservation of number though with variations in the ages of attainment

**Table 2:** Conservation of Mass by 2-7 year Old at the Pre-operational stage

Age	Conservers		Non-Conservers		Total
	Frequency	Percentage (%)	Frequency	Percentage (%)	
2	0	0.0	96	100.0	100
3	2	2.1	94	97.9	100
4	8	8.5	86	91.5	100
5	26	27.1	70	72.9	100
6	36	37.5	60	62.5	100
7	32	33.3	64	66.7	100
Total	104	100	470	100	

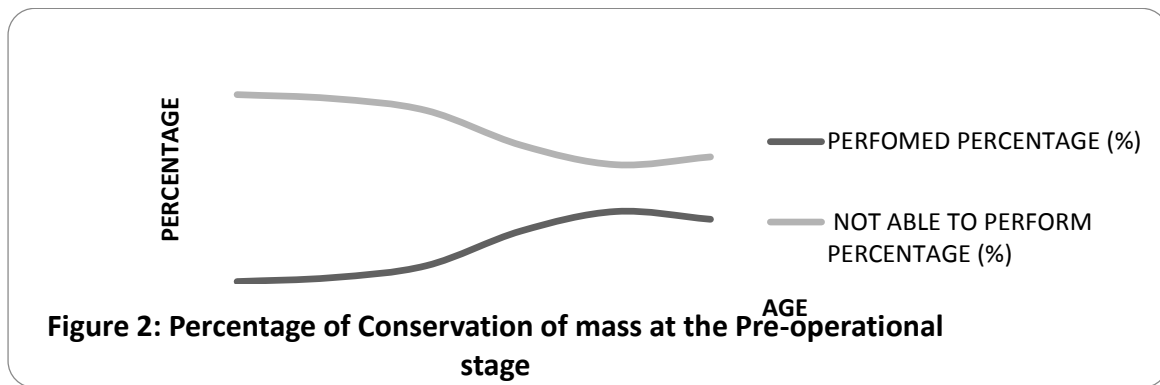


Table .2 shows children performance on conservation of mass at the pre-operational stage of mental development. Result of this study showed that 3 year old children have demonstrated the ability to carry out conservation of mass tasks and this ability increases with increase in age. At the age of 7, 33.3% of the pre-operational thinkers have already mastered conservation abilities. Only 66.7% are yet to do so. The table further showed that while

the proportion of children who demonstrated the ability to conserve increased progressively with increasing age, those who could not do so decreased steadily. . Contrary to Piaget’s views that children at the pre-operational stage (2-7yrs) cannot perform conservation tasks until they reach concrete-operational stage (8-12yrs).Most children conserved earlier than the age stated by Piaget.

**Table 3:** Conservation of Length by 2-7 Year Old at the Pre-operational stage

Age	Conservers		Non-Conservers		Total
	Frequency	Percentage (%)	Frequency	Percentage (%)	
2	0	0.0	96	100.0	100
3	5	5.2	91	94.8	100
4	16	16.7	80	83.3	100
5	34	35.4	62	64.6	100
6	46	47.9	50	52.1	100
7	63	65.6	33	34.4	100
	164	100	412	100	



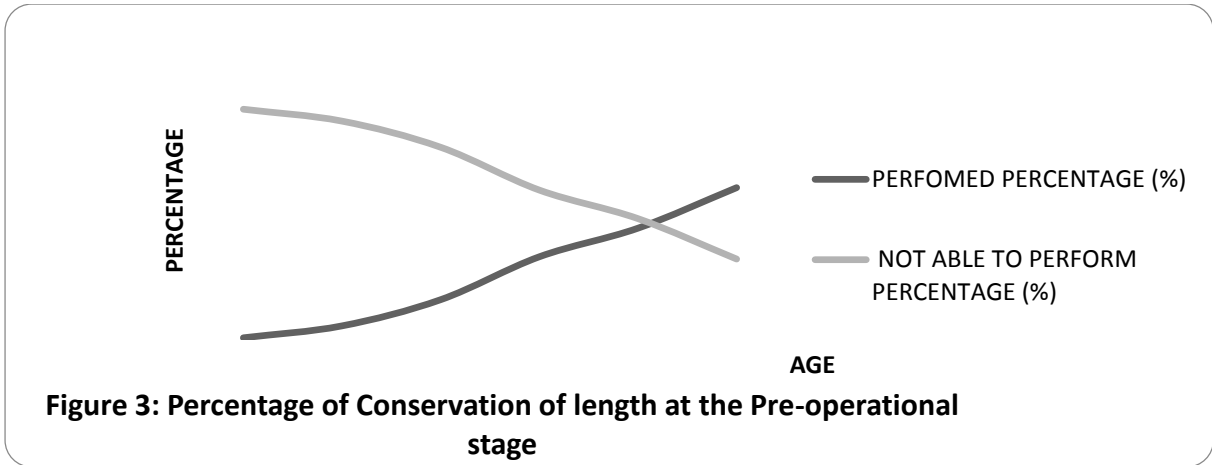


Table 3 shows children’s performance on conservation of length at the pre-operational stage of cognitive development. The chart reveals that 5.2% of the children demonstrate the ability to conserve at the age of 3 and this ability increases with increase in age. 65.6% of the children had already acquired the ability to conserve. The inability to perform conservation of length tasks decreases with increase

in age. At the age of 7, 34.4% were not able to perform conservation tasks. This finding is therefore not in line with Piaget’s theory who posited that children below the age of 8 would not be able to perform any form of conservation tasks.

**Table 4:** Conservation of Liquid by 2-7 Year Old at the pre-operational stage

Age	Conservers		Non-Conservers		Total
	Frequency	Percentage (%)	Frequency	Percentage (%)	
2	0	0.0	96	100.0	100
3	6	6.3	90	93.8	100
4	6	6.3	90	93.8	100
5	19	19.8	77	80.2	100
6	40	41.7	56	58.3	100
7	33	34.4	63	65.6	100
	104	100	472	100	

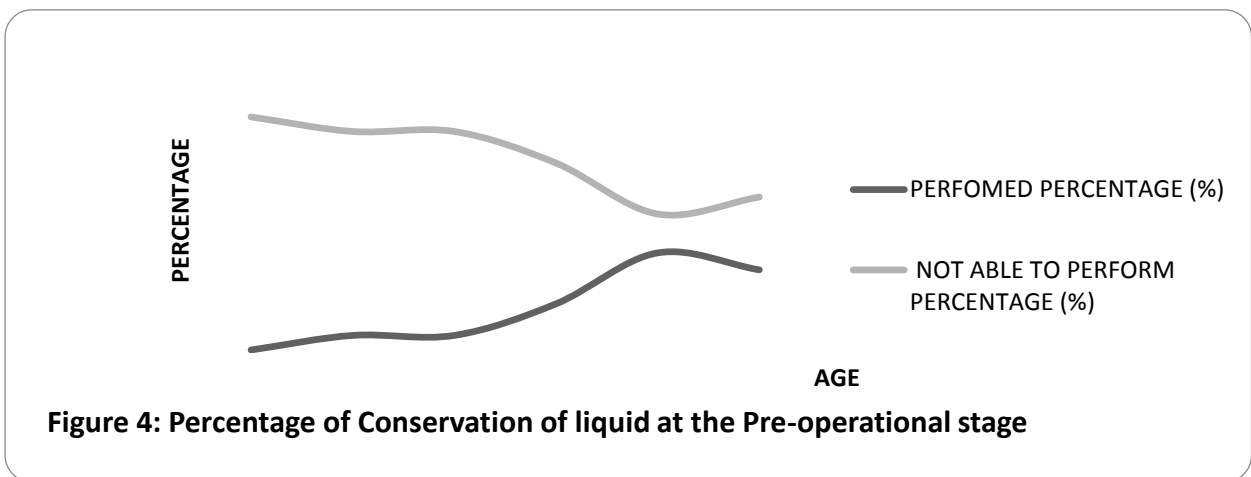


Table 4 reveals that about 6.3 % of the children at the age of 3 demonstrate the ability to carry out conservation tasks and this ability increases in complexity with age. The table showed that while the proportion of children that conserved liquid rose

steadily with increasing age, those that could not conserve decreased progressively with increasing age. Children therefore exhibited this attribute but with variations in the ages of attainment

**Table 5:** Conservation of Weight by 2-7 Year Old at the pre-operational stage of mental Development

Age	Conservers		Non-Conservers		Total
	Frequency	Percentage (%)	Frequency	Percentage (%)	
2	0	0.0	96	100.0	100
3	0	0.0	96	100.0	100
4	5	5.2	91	94.8	100
5	12	12.5	84	87.5	100
6	26	27.1	70	72.9	100
7	42	43.8	54	56.3	100
	85	100	491	100	

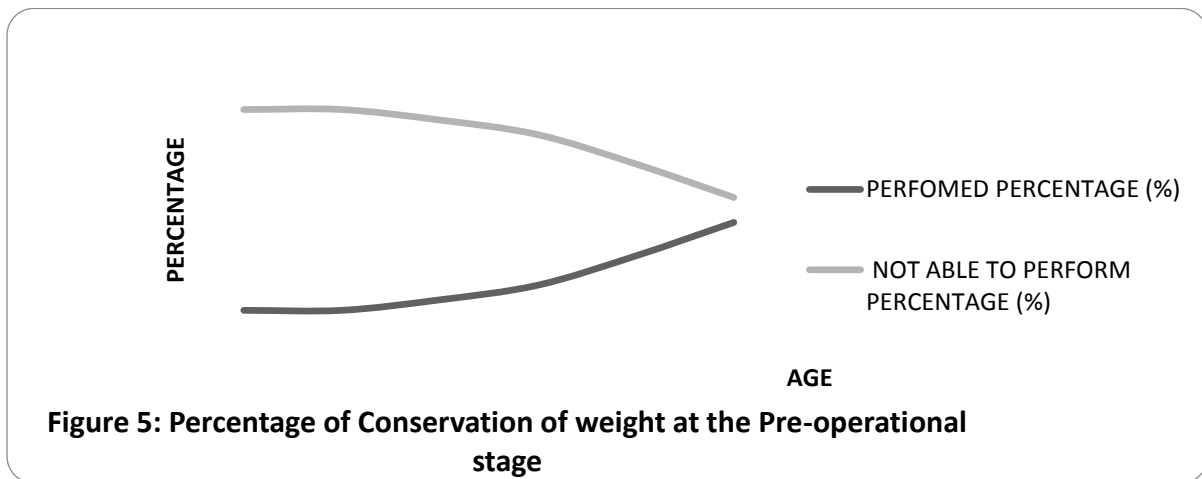


Table 5 shows the analysis of children’s performance on conservation of weight at the pre-operational stage. The results of analysis shows that a high proportion of children were not able to conserve weight. The ability to do so increased progressively with increasing age. According to

Piaget’s Postulation, children under the age of eight would not be able to carry out conservation tasks. However, contrary to this assumption, data analysis had shown that conservation ability was noticed at the age of 4 and progressed with increase in age.

**Table 6:** Conservation of Volume by 2-7 Year Old at the pre-operational stage

Age	Conservers		Non-Conservers		Total
	Frequency	Percentage (%)	Frequency	Percentage (%)	
2	0	0.0	96	100.0	100
3	2	2.1	94	97.9	100
4	10	10.4	86	89.6	100
5	10	10.4	86	89.6	100
6	43	34.1	83	65.9	100
7	62	64.6	34	35.4	100
	127	100	447	100	

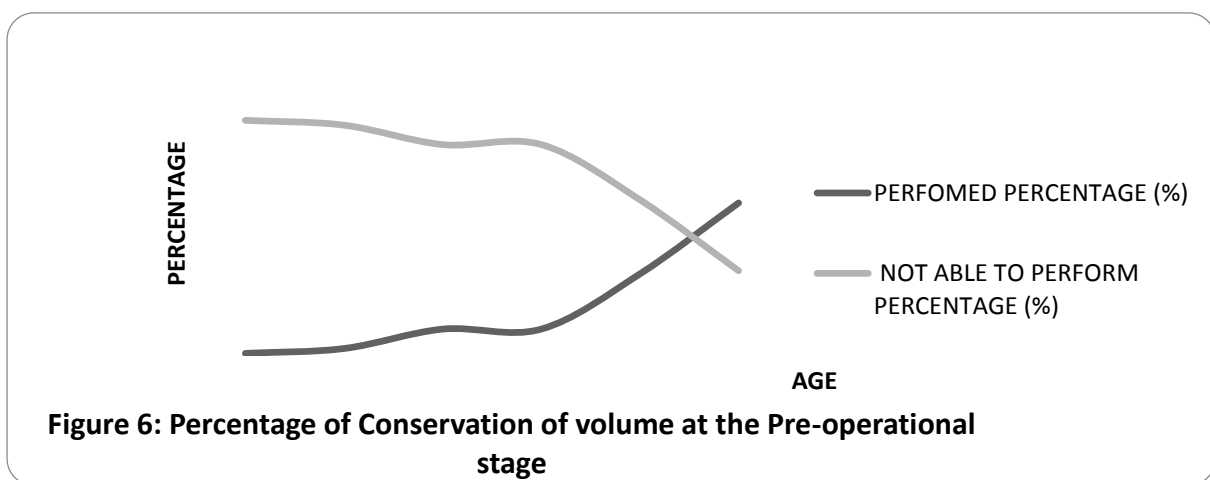


Table.6 shows children’s performance on conservation of volume at the pre-operational stage of mental development. From the analysis above, children’s inability to conserve volume decreases with increase in age. This means that while there is a steady increase in children’s ability to conserve with increasing age, those who could not conserve, decreased progressively with increasing age. At the age of seven, 35.4% of the children would not conserve volume as against 97.9% at the age of 3. However, children’s ability to conserve volume was manifested at the age of 3 and progressed with increase in age. The result of the analysis therefore

showed that children exhibited the mental characteristics of volume conservation as posited by Piaget though with variations in the ages of attainment.

***Hypothesis 1: There is no significant difference between boys and girls in performance on Piagetian tasks at the pre-operational stage of cognitive development.***

The results of the analyses are presented based on the mental characteristics such as conservation of number, mass, length, liquid, weight and volume. The results are presented on tables 7-12.

**Table 7:** K-S analysis of performance boys and girls on conservation of number at the pre-operational stage

Age	2	3	4	5	6	7	N
Cum. F (Boys)	4/214	12/214	30/214	160/214	214/214	184/214	288
Cum % (Boys)	0.02	0.06	0.14	0.75	0.86	1.00	
Cum. F (Girls)	0/74	4/74	12/74	27/74	41/74	74/74	
Cum % (Girls)	0	0.05	0.16	0.36	0.55	1.00	
$\bar{d}$	-	0.02	0.01	0.02	0.39	0.31	0

P. Level: 0.18 Decision: Significant.

Table.7 shows that the null hypothesis was rejected which means that there is a significant difference (Kolmogorov Z=0.39) between boys and girls in performance on conservation of number at the pre-

operational stage. From the analysis, boys had an advantage in performance on the conservation of number tasks

**Table 8:** K-S analysis of performance between boys and girls on conservation of mass at the pre-operational stage

Age	2	3	4	5	6	7	N
Cum. F (Boys)	0/60	0/60	7/60	21/60	40/60	60/60	134
Cum % (Boys)	0	0	0.12	0.35	0.67	1.00	
Cum. F (Girls)	0/74	2/74	6/74	19/74	49/74	74/74	
Cum % (Girls)	0	0.03	0.08	0.26	0.66	1.00	
$\bar{d}$	-	0	-0.03	0.04	0.09	0.01	0

P. Level: 0.24 Decision: Insignificant.

The result of analysis in which the calculated Kolmogorov Z (0.09) is less than the significant value (0.24) at  $p < 0.05$ , show that the null hypothesis is accepted meaning that there is no significant

difference between boys and girls in performance on conservation of mass at the pre-operational stage. Girls and boys seem to perform at the same intellectual level.

**Table 9:** K-S analysis of performance between boys and girls on conservation of length at the pre-operational stage

Age	2	3	4	5	6	7	N
Cum. F (Boys)	1/100	5/100	18/100	47/100	76/100	100/100	166
Cum % (Boys)	0.01	0.0	0.18	0.47	0.76	1.0	
Cum. F (Girls)	1/66	5/66	10/66	20/66	48/66	66/66	
Cum % (Girls)	0.2	0.09	0.15	0.30	0.72	1.0	
$\bar{d}$	-	-0.19	-0.04	0.03	0.17	0.04	0

P. Level: 0.22 Decision: Insignificant.

The result of the analysis on table 9 shows that the calculated Kolmogorov Z (-0.19) is less than the Significant value (0.22) at  $P < 0.05$ . The null

hypothesis is therefore accepted which means that there is no significant difference between boys and girls on performance on conservation of Length.

**Table 10: K-S analysis of performance boys and girls on conservation of liquid at the pre-operational stage**

Age	2	3	4	5	6	7	N
Cum. F (Boys)	0/75	0/75	7/75	15/75	43/75	75/75	170
Cum % (Boys)	0	0	0.09	0.2	0.57	1.0	
Cum. F (Girls)	0/95	4/95	14/95	34/95	66/95	95/95	
Cum % (Girls)	0	0.04	0.15	0.36	0.69	1.0	
d	-	0	-0.04	-0.06	-0.12	0	

**P. Level: 0.21 Decision: Insignificant.**

Table 10 shows that there is no significant difference (Kolmogorov  $z=-0.16$ ,  $P<0.05$ ) between boys and

girls in performance on conservation of liquid at the pre-operational stage.

**Table 11: K-S analysis of performance boys and girls on conservation of weight at the pre-operational stage**

Age	2	3	4	5	6	7	N
Cum. F (Boys)	0/61	2/61	6/61	18/61	33/61	61/61	199
Cum % (Boys)	0	0.03	0.09	0.29	0.54	1.0	
Cum. F (Girls)	0/38	2/38	3/38	7/38	16/38	38/38	
Cum % (Girls)	0	0.05	0.07	0.18	0.42	1.0	
d	-	0	-0.02	0.02	0.11	0.12	0

**P. Level: 0.28 Decision: Insignificant**

The result of analysis in table 11 shows the Kolmogorov Z (0.12) is less than the significant value (0.28) at  $P<0.05$ . The null hypothesis is therefore accepted which means that there is no

significant difference in performance on conservation of weight tasks between boys and girls at the pre-operational stage.

**Table 12: K-S analysis of performance boys and girls on conservation of volume at the pre-operational stage**

Age	2	3	4	5	6	7	N
Cum. F (Boys)	0/79	0/79	7/79	17/79	41/79	79/79	141
Cum % (Boys)	0	0	0.08	0.22	0.52	1.0	
Cum. F (Girls)	0/62	1/62	3/62	14/62	35/62	62/62	
Cum % (Girls)	0	0.02	0.05	0.23	0.56	1.0	
d	-	0	-0.02	0.03	-0.01	-0.04	0

**P. Level: 0.23 Decision: Insignificant.**

Table12 shows that there is no significant difference (Kolmogorov  $Z=-0.04$ ,  $P<0.05$ ) between boys and girls in performance on conservation of volume at the pre-operational stage. The null hypothesis of no significance in performance between boys and girls is therefore accepted in favour of its alternative. This means that boys do not perform better than girls on conservation of volume tasks

though with variations in the age of attainment. The experimenter conducted experiments on both pre-operational and concrete-operational thinkers in order to bring out their sharp distinctions. Conservation of number task was the first attribute that was experimented. The aim was to determine whether children’s visual impression of the length of the row of chewing gum overrides the numerical equality of the objects or they consider numerical equality more important than visual impressions.

**Discussion**

The findings of research questions one revealed that children between the ages of 2-7 years in Mayo-belwa local government area exhibited the mental characteristics at the pre-operational stage as postulated by Piaget’s theory of mental development

The researcher, using the recommendations of previous studies on the use of familiar materials, made use of stimulus materials (Apple Chewing Gum) to conduct the experiment on the conservation

of number. This enhanced the performance of testees considering the level of interest shown during experimentation. The testees were told that they will be given part of the chewing gum after the experiment. When pieces of chewing gum were presented, greater attention was paid and this led to the subjects' demonstration of the skills they had. The result of the experiment showed that contrary to Piaget's (Piaget, 1977) assumption that conservation ability begins from the ages of seven or eight, some pre-operational thinkers were able to conserve number while some at the concrete-operational did not. Non-conservers at the pre-operational stage argue that pieces of chewing gum which are spread out are more in number than the same number of chewing gum that are put close together in a row. These children had earlier confirmed the equality of number of the chewing gum. The children think that the equality of the sets is disrupted by their spatial arrangement. The finding of this study agrees with the work of Bidell (1999), Santrock (2001) and Morra (2003) who, together with their colleagues investigated the conservation of number among kindergarten pupils. In their study, two groups of objects were arranged in front of a child in parallel row in such a way their numerical equality was clear. One of the rows was re-arranged and the child's awareness of the persistence of numerical equality was assessed. The children insisted that the longer row contains more objects than the clustered objects. At this stage, the impression of length overrides the numerical equality of number. The qualitative interrogations have also been confirmed by Piaget & Inhelder (1969)

The experiment the researcher conducted on conservation of substance (mass) was very exciting. The descriptive analysis of children's performance on conservation of mass at the pre-operational and concrete-operational stages showed that some pre-operational children conserved mass earlier than the age stated by Piaget. Similarly, some concrete-operational thinkers were found to operate at the pre-operational stage. There was clear evidence that the thinking of non-conservers was dominated by perceptual centering. Children could centre but could not de-centre particularly at the early period of pre-operational stage. They focused their thought on single dimension at the neglect of others. Most of the children argued during experimentation that the amount of clay was more because it was longer. Others did not give a reason to justify their answer. At the age of 8-12 years, most of the children

conserved mass because they gave satisfactory answers showing evidence of conservation. Examples of statement made are: "All of them are the same; as they were the same before". A few of them say that their ball of clay has only undergone a change of shape. The conclusion of this experiment lends credence to the work of Piaget (1952) who theorized that children between the ages of 4-7 years are dominated by thought centring on one aspect of the situation while ignoring other aspects. The result of this experiment is also backed by other studies and cross-cultural researchers such as Ogilvie and Lovell (1960), Otalla (1973), Santrock (2001), Humel (2003) etc.

Experiments on conservation of length were also carried out to determine the extent to which children could conserve equality or inequality of length. From the experiments conducted, many children at the pre-operational stage conserved length successfully while the majority did not. Similarly, while most of the children at the concrete-operational stage conserved length, a few did not. When the researcher placed two pencil Candies or two identical sticks evenly side by side, children correctly judged that the sticks were the same length. However, when one of the sticks was moved slightly to the right of the other, some children under the age of 7 thought that the moved stick was longer than the unmoved one. Furthermore, when presented with a stick and a sinuous one equal in length with the same end points, many of them could not identify the illusion and argued that they were the same. Most of the testees between the ages of 8-12 saw the illusion and confirmed that the sinuous stick was longer than the straight stick though the end points were the same. Asked why, they confirmed that if the sinuous stick was stretched, it would be longer.

The behaviours exhibited by these children during experimentation are very similar to the ones obtained by Piaget (1969; 1971). However, performance of these children on this experiment did not agree with the findings of Murray (1976) Piaget, Inhelder and Steminka (1960) who reported that children under the age of 8 would not conserve length. This study found out those children at the age of 3-7 conserved length including illusion producing lines contrary to Piaget's postulation.

The results of the experiments on conservation of liquid tasks showed that some children at the pre-operational stage successfully liquid while a few at

the concrete-operational stage could not, contrary to Piagetian assumptions. During experimentation, many of them at the concrete-operational stage agreed that the amount of water in the bigger container is equal to the amount in the thin tumbler in spite of the great perceptual differences in the shape of the container.” It is the same because the container is bigger and insists that the amount of water in the tall thin glass is more than the water in the wider container even when the water was poured into it in the full view of the child. According to 4-6 year olds, the water in B is higher than it was in A and this means that it has increased in quantity regardless of the fact that it is the same water that has merely been poured from one container to another. The child does not believe that changes in the physical appearance of the container do not affect the quantity. This finding corroborated the studies of Piaget & Inhelder (1969,1973). Older children at the concrete-operational stage believe that ‘it is the same water’, nothing has been added or taken away, you can put the water in B back into A where it was before”.

When the researcher raised one of the thin glasses with the help of a book, children respond that the two glasses do not have the same amount of water. They believe that the taller glass has more water. The results of this study have confirmed, though with variation at the age of attainment that the mental characteristics at this age are similar to the ones described by Piaget. It has also supported the work of Elkind (1961) and Serafine (1988) whose study concluded that perceptual centration is very strong even in a task involving a one dimensional change. Other studies such as Gross (2005) & Edwards (2006) have also confirmed that pre-operational children have the tendency to focus on only one aspect of the problem while those in the concrete-operational stage consider many aspects of the problem or situation at the same time. They understand that a tall slender container can hold the same amount of water as a short broad one.

The analysis of data on conservation of weight revealed early and late conservers at the pre-operational and concrete-operational stages. Most children gave many of the same kind of responses as the conservers in Piaget’s sample and other replication studies. The older children gave more reasons for a judgment than younger children. For most non-conservers, weight is related to the degree of fitness or thinness. However, conservers reject

this view that fatness or thinness of substance does not affect weight. Those children who are in the stage of concrete-operational stage that could not conserve weight are due to arrest (fixation) in the acquisition of experience in the physical world (Ogilvie & Lovell, 1960). The results of this experiment therefore are in line with the study of (Elkind, 1961; Ogilvie & Lovell, 1960; Bidell (1999) who reported that cultural differences and learning could lead to differences in performance. The results of the experiment on conservation of volume tasks identified early and late conservers at the pre-operational and concrete-operational stages respectively. During experimentation, the researcher poured water into two beakers A and B under the full view of the child. When a stone was dropped into one of the containers, non-conservers admitted more water is contained in the container with the raised water level. Non-conservers consider only the height of water level in the container while ignoring the stone that increased the water level. The result of the experiment confirmed the findings of Durojaiye (1979) and Serafine (1988), King (1960).

Hypothesis formulated was also tested to determine the extent of genders’ conservation abilities. The result showed that boys and girls did not differ significantly in performance on conservation of number, mass, length, weight, and volume at the pre-operational and concrete-operational stages of cognitive development. This finding is not in agreement with the studies of Bomide (1986) who reported sex differences in performance on intellectual tasks.

### **Conclusion**

Based on the findings of this study, it was concluded that children between the ages of 2-7 in Mayo-Belwa Local Government Area of Adamawa State exhibited all the mental characteristics of pre-operational and concrete-operational stages of Piaget’s theory of mental development but with variations in the ages of attainment. According to Piaget, children’s performance on each Piagetian task is automatic. Once a child reaches a particular age, he is able to carry out successfully all the tasks designated for that stage. Contrary to this supposition, this study found that while some children across the age levels performed Piagetian tasks earlier than the stated stage, others performed at a later date stage. This means that Piaget’s stage theory therefore is not absolute in our school and

cultural environment. There are bound to be variations in the ages of attainment.

The study did not find any significant difference in performance on conservations of number, mass, length, liquid, weight and volume between boys and girls. This study corroborates Piaget's theory of mental development who did not consider sex as important determinant for performance on mental tasks. This has therefore strengthened the universality in the use of the theory

### Recommendations

Consequent upon the findings and discussions of results, the following recommendations are made for the improvement of children's academic and social wellbeing:

- i. The study found out that children between the ages of 2-12 years exhibited all the mental characteristics as posited by Piaget though with variations in the ages of attainment. It is therefore recommended that in using the theory, the age levels should not be taken as absolutes
- ii. The study did not find any significant difference in performance on Piagetian tasks between boys and girls, urban and rural school children, private and public school children, and schooled and unschooled children. It was therefore recommended that teachers should treat all learners particularly those who are not doing well in school subjects with empathy. They should know that all human beings are born with potentials to be developed but environmental factors such as material diseases, poor nutrition and language lead to poor growth and development which restrict the acquisition of relevant experience that are necessary for the process of assimilation and accommodation which are critical in the development of intelligence.
- iii. The study also found out that some 12 year old children could not perform simple classification and seriation tasks which are contrary to Piaget's theory. Handling students based on their chronological age should be done with caution. Children's behaviour should form the basis of assessment and not their chronological age alone.

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