A Study of Cognitive Abilities of Lower Primary School Pupils, in Igembe Central Division of Igembe District, Kenya

Mauta Kaindio Peter

School of Education, Mount Kenya University
kaindiomauta@yahoo.com

Doi:10.5901/mjss.2014.v5n5p

Abstract

The learning environment and childhood experiences of children from rich and poor families are never the same. This is because they come from different home environments and attend different schools that have different facilities, and therefore exposed to quite different experiences. The children from rich families attend private primary schools whose learning environment is conducive and stimulating, while those from poor families attend public primary schools, which are often crowded and with poor facilities. At home boys and girls are exposed to different activities due to the dictates of the culture and their gender roles. Researches done by developmental psychologists on the cognitive abilities of children of different cultures and environment sometimes give different results. Kiminyo (1988) conducted such a study among Akamba children in Kenya, of ages between 7-8, 9-10 and 11-12 years. It involved deforming one plasticine ball, and then children were asked if the mass of the deformed "ball" was the same as that of an un-deformed one. The results that the younger children did not notice the contradiction posed by the question, but the older children were quick to point out that there was nothing added or subtracted, therefore the mass remained the same. His study aimed at establishing the age at which Akamba children conserve the cognitive task of mass. The study aimed at finding out whether the environment, gender, and age difference of two years among concrete operational children of Meru of Kenya play any role on conservation of cognitive tasks of length, mass, substance and volume.

Keywords: *Children, Cognitive. Pupils, Schools, Learning, Tasks*

1. Background to the Study

As children advance in age, they actively acquire experiences in their environments, and internalize their cultural values that eventually make them different from children of other cultures. The cognitive abilities therefore become the product of both their inborn mental abilities and the environmental factors. The question that arises among psychologists is to whether it is the environment or the inborn mental abilities that contributes more in children's performance of cognitive tasks.

The environment, under which children live and learn, is an important factor in knowledge acquisition, since they are active and not passive. When they play, go to school, take care of the family livestock, and attend to shamba, cook, and wash clothes, all are activities that form learning experiences. However, socio-economic status determines the environment under which the child is exposed to and therefore the type of experience the child gets. Children from affluent families are exposed to quite different environment compared to those from poor families both in school and at home.

Researches done by developmental psychologists point out that children from different cultures perform differently on cognitive tasks. Kiminyo (1988) reports about some researches done in developed and developing countries on cognitive abilities of children of different ages. The results show that children from developed countries constantly performed better in all the cognitive tasks in comparison to children from developed countries. Many of those studies involved cognitive tasks of transformation and observation of length, mass and volume. One such study was done in Zambia, from where it was reported that children above 11 years old would only achieve 55 -60% conservation level in comparison to children from developed countries who achieved more than 80% (Kiminyo, 1988).

Gender of the child is another factor that determines the experience the child goes through at home. For example among the Meru people, boys and girls have defined roles at home. Girls help their mothers in meal preparations. During meal preparation certain measurements of the food ingredients are elaborately used which involves cognitive abilities of measurements, transformations, and conservation of substances and therefore this gives girls exclusive experiences. For example, during the preparation of *chapatti,* they make and flatten the 'balls' of wheat flour, and this enhances the

cognitive abilities of conservation of mass. Boys likewise engage in cognitive activities as they actively engage themselves in activities that are in agreement with male gender. For example, they engage themselves in constructing of simple structures at home where measurements are required, such as finding how many posts are needed to construct a fence, and this assist them in acquiring cognitive abilities of numbers.

Socio-economic factors determine the childhood experiences. Children who come from high social economic families are exposed to different learning environment both in school and at home as compared to those children who come from poor families. Children from affluent families sometimes do not get opportunities to do some activities like washing clothes for themselves since the house helpers and other family workers do that work. They are driven to school and brought back in the evening by the family car or by the school van. The opposite is true for children who come from poor families. They do many things on their own. The schools they attend are not the same in terms of facilities and learning materials. Private schools in which children from the rich families attend motivated teachers, and supervision of pupils is better than those in the public primary schools.

It was against this background that the researcher conducted a research on pupils of private and public primary schools in order to find out if the two school environments, gender, and age difference of two years, in children who are at concrete stage, could have any significance influence on the performance of cognitive tasks of conservation of length, continuous substance, mass and volume.

2. Theoretical Framework

When it comes to the study of children's cognitive abilities, the most influential psychological theories is that of Piaget (Pulaski, 1969). This theory dominates the landscape in studies dealing with children's intelligence. Crain (1980) argues that there is hardly a study of children's thinking that does not refer to Piaget's theory of intellectual development. It postulates that thought processes develop sequentially. According to Piaget, four factors are associated with intellectual development (Nyiti, 1973). These are:

- **Maturation** – the biological development that brings about physical changes in child's body.
- **Experience** – the sensory stimulation that leads to cognitive growth. Experience can be physical or mental activity such as perception or problem solving.
- **Social interaction and transmission** – this occurs when information, attitudes and customs are transmitted from one person to another.
- **Equilibration** – this is self-regulatory process that keeps the individual on the right tract. For example, when the child hears contradicting statement, his/her equilibrium is disturbed and he/she set out in search of an answer, which will enable him to achieve a new and high equilibrium.

Child's view of the world does not change in a smooth fashion, but rather the emergence of intellectual sophistication involves distinct periods of cognitive development. These periods develop in stages and Piaget conceptualized them into four broad categories in order of occurrences, namely:

Sensorimotor stage (0-2 years): This period starts from the time of birth and ends at the age of about two years. An infant in this stage of development experiences the world almost entirely through sensory and motor experiences. Knowledge gained during this period is acquired through sensation, as the infant lacks the capacity for mental representation. Intellectual growth at this stage depends on physical, emotional and social environment. Kiminyo (1988) says at the end of this period, speech has sufficiently developed that enables the child to give representation of mental images of an absent person or object he has in his mind.

Preoperational stage (3-6 years): This period starts from around age two years and ends at about seven years. The preoperational child fails to conserve because he/she is unable to recognize the operation certain processes in the physical world. In a test of conservation of substance. Piaget showed children water from two equal-sized glasses being poured into a tall, thin glass and a short wide one and then asked them if one glass contained more water than the other. Children at this stage of development guessed that one glass (usually the taller one) contained more (Liebert 1981).

Characteristics of preoperational child are:

- Inability to see the reversibility of certain physical operations
- Centration that appears to prevent their conservation of cognitive tasks
- Perception of states rather than transformations that prevents the solving of conservation problems.

However, the child has now the capacity for mental representation and has acquired semiotic function and language.

The concrete operation stage (7-11): This period starts from around age seven years and ends at around eleven

years. The period of concrete operations is characterized by an orderliness of thinking that gives rise to the ability to decentre and recognize transformations-awareness that some transformations are reversible. They have the ability to conserve numbers and amounts and also cognitive abilities of sorting objects into classes or series by systematic searching and ordering (Bernstein, 1997).

The child's ability to represent the world symbolically is greatly advanced at this stage though thinking is limited to actual concrete things.

Formal operation stage: This period starts from age eleven years that is around puberty stage. The children begin to reason realistically and think in an abstract way, whereby he develops abilities to even advance the hypothesis and formulates instruments to test it. They develop the ability to imagine other worlds, especially the ideal ones that reflect their own activities of thinking (Bernstein, 1997).

2.1 Environment as a factor in intellectual development

Elkind and Flavel (1969) say that the human beings are immersed right from birth in a social environment, which affects them just as much as their physical environment. They go further to say that social interactions and stimulation are significant factors for the development of intelligence. The school provides a social environment that significantly influences the development of logical thinking. The two researchers went on to give educators advice on enhancing the cognitive development of children. It is important for educators to be aware of the fact that cognitive structures are not fixed or given but develop, and in the process of adaptation, become modified and reconstituted as new mental structures. More important for the educators to know is that intelligence is developmental and involves acquisition of knowledge and skills at different stages.

John, David and Hellen (1983), assents that, the child will not shift from concrete stage to formal operation until the adolescence environment and experiences are provided. Bernstain (1997) emphasized the role of environment in intellectual development by pointing out the weakness in Piaget's ideas. Piaget's ideas fail to explain why in many instances, children master tasks that are logically equivalent at very different points in their development. It is also hard to explain why a child's cognitive performance on two logically similar tasks is often very different. He says that Piaget's exclusive emphasis on the predetermined 'Logical' aspects of children's thinking often does not match the actual thought processes. Children appear to use and largely ignores the social emotional and cultural factors that influence the process.

Ginsburg and Opper (1969) say that the environment does not mould behavior by imposing itself on the child's response but the infant is active. They suggested three factors that influence the cognitive development of the child. They are:

- The child's interpretation of the events. The interpretation of the event and not the event itself plays big role in cognitive development. The social context influences the child's interpretation of the event.
- Experiences. In order to clarify objects, the child must see some of them. To speak a language, the infants must first hear people talking that language. Contact with objects lead to two types of mental experiences, physical experiences and logical mathematical experiences that result in knowledge that is acquired through an internal co-ordination of the individuals' action.
- Social transmission. This is obtaining information by reading books, receiving instructions from teachers and imitation from models.

Cain (1980) remarked that experience is always for intellectual development. He emphasized the importance of physical activities and social interactions as ingredients of experience. Learning is a process provoked by external situations such as psychological, since environment nourishes, stimulates and challenges the child.

Benstain (1997) noted that cognitive development is profoundly delayed if children are raised in an environment where they are deprived of the everyday sights, sounds and feelings provided by books, television, and radio and family members. He further went on to note that children subjected to such severe deprivation show marked impairment in intellectual development by the time they are two or three years old. Cognitive development may also be impaired by less extreme conditions of deprivation, including the neglect, malnourishment, noise and chaos that occur in some homes.

Hetherington and park (1979) found out that there was significant improvement in children's cognitive abilities in solving intellectual problems after experiencing some form of social interaction.

Kiminyo (1988) says that the growing African child needed an atmosphere provided by African cultures (environment). The child learned a lot from his siblings, grandparents and parents by participating in their daily chores such as weeding, hunting and trading. The child grew up knowing exactly what society expected of him and this gave him confidence in his future life. He went on to say that the confidence the child acquired influenced the growth of his cognitive development.

Kimamo (1991) in his thesis reported the work of Dodwell (1960) on the study of achievement abilities and socio-economic levels of the subjects. The study involved 250 subjects from five Canadian schools, representing all socio-economic levels and ranging in age from 5.1 to 10.1 years. The children were tested on conservation of numbers using familiar items to them like bread, eggs and eggcups. Dodwell (1960) was able to identify the three stages of non-conservation, transition and conservation. He found that the children drawn from high socio-economic families consistently performed better.

Kiminyo (1988) said that children from diverse cultures would be expected to show differences in cognitive tasks performance, if selection of cognitive tasks does not take into consideration their different cultures. For example, researches done using subjects from different Kenyan communities have shown that there are tendencies for girls to do better than boys in some cognitive tasks and for boys to do better in others. He also found out that subjects from rural areas differ from urban subjects in cognitive task performance. Further, low socio-economic urban subjects also tend to differ in cognitive tasks performance from high socio-economic urban subjects.

Ndambuki (1987) stressed the importance of the environment in knowledge acquisition. She argues that learning is acquired through imitation and observation following social interaction of children with other children and adults. She asserts that a rich environment may accelerate cognitive development.

Otaalo (1970) in his thesis found out that rural school children and unschooled Teso adults performed quite poorly in Piagetian tasks of length, mass and volume as compared to urban school children who are assumed to have a more stimulating environment. He concluded that children's cognitive abilities of solving intellectual problems are greatly improved after experiencing rich and stimulating environment.

2.2 Age as a factor in intellectual development

Bernstain (1977) says that children's thinking goes through the same stages, in the same order, without skipping and building from previous stages, and then progressively moving to the higher ones. Entering each stage involves a qualitative change from whatever preceded it, thus the thinking of infant is different from the thinking of children, and the thinking of children is different from that of adolescent.

Inhelder (1968) argued that the order of succession of stages is constant, and thus no child can skip any stage or sub-stage to attain higher stages before attaining the lower ones. However, the ages of attainment can vary considerably between populations as a function of maturation, experience, culture and equilibration.

Ginsburg and Opper (1969) emphasized the biological maturation of the child in intellectual development by saying that the children must possess the cognitive structures that can assimilate the information. For example, the 5-year child cannot learn mathematical calculus, however well it is socially transmitted because he does not have the prerequisite structures.

Elkind (1961) asked 175 school children to predict, judge and explain a conservation of mass, weight and volume in systematic replication of Piaget's investigation. The results of the study agreed with the Piaget's findings regarding ages at which children discover conservation of mass, weight and volume. The tasks were also mastered in the same invariant order of mass, weight and volume as stipulated by Piaget.

Cain (1980) argued that children do not follow a rigid chronological timetable, and therefore disputes the Piagetian theory that the sequence in which the stages appear is invariant and universal and Brainerd (1978) noted that conservation was rarely present among four and five year old children when justification is required. He argued that data showing conservation in very young children is confounded by the fact that subject tends to agree with the investigator more frequently than they disagree.

Berry (1975) in his study, reported that children around the age of 6-7 years achieve conservation of continuous and discontinuous quantity. Conservation of weight and volume are achieved at the age 9-10 and 11-12 years respectively. He went on to say that children at the age of 12 years acquire ability to think multidimensional, which involves an understanding of both compensation and negation.

John David and Hellen (1983) argued that children do not have the ability to reason in a deductive way until they reach the age of 12 years. However, they noted that not all teenagers and adults achieve full formal operations. They estimated to about 50 to 60% of adolescents and adults who are able to perform well on the tasks measuring formal operations. They say that formal operations involve abstructions and ignoring aspects of stimulus objects that are irrelevant to the operations involved. The child at this stage and with the ability of formal operation can imagine systematically all possible combinations and outcome. They can imagine circumstances, deduce outcomes and examine evidence to see if the premises are compatible with what is observed.

Kimamo (1991) in his thesis, quoted Mehler and Bever (1967) who argued that children between ages of two

years-six months and three years-two months could conserve but this ability was then lost until the age of four years-six months.

2.3 Gender issues in cognitive abilities

Cathy (1981) notes that in all known societies, biological distinctions between men and women are not only observed and acknowledged, but serve as a basis for social differentiation. She further says that topic for debate has always been whether boys and girls differ generally in level of intelligence. It is obvious that men have garnered the vast majority of high positions and prizes in business, government and science, but it is also obvious that opportunities have not been equal for both sexes.

William, James and Timothy (1984) argue that boys perform better than girls on standardized intelligence test because most items in the tests favour boys. Most items reflect the different experiences boys and girls are given in different cultures. They say that in the past items that dealt with dolls, dress, food and family tended to favour girls and items about machinery, sport, Science and weapons tended to favour boys. In one such test they reported that 53% and 47% boys and girls respectively scored equal marks in some culture. When the same test was administered to boys and girls of the same age but of different culture, 68% boys showed the ability in comparison to 32%, showing that culture plays a big role in intellectual development. The different in performance is culturally determined and not innate abilities of boys over girls. They went on to argue that teachers reward girls for being passive and dependant and reinforce boys for being aggressive. If these personality characteristics become important in the pursuit of skills and information in the development of effective intelligence, then girls will be handicapped in their training.

Winfred (1970) says that girls naturally score lower because they have been socialized towards traditional female value of interdependence and responsibility for others. She further argues that girls are less motivated to solve problems, because they have been less reinforced for problem solving. She concluded by quoting evidence from anthropology that asserts that independent problem attacking types of behavior are more rewarded for boys and routine types of behavior are rewarded for girls in many cultures.

William, James and Timothy (1984) argue that some abilities boys or girls possess form a pattern across many cultures and this lead people to believe that an actual difference in cognitive abilities do exist among sexes. It is believed that girls talk a lot and it is not a surprise to find girls excel in verbal fluency. It should be noted that girls do not have large vocabularies than boys. Boys in turn are better at solving arithmetic and science problems and have a better grasp of spatial relations. Girls are better at motor tasks involving fine co-ordinations, whereas boys are better at tasks requiring strength. They concluded by saying that the differences noted among girls and boys are as a result of the culture or educational system, though they appear to be genetically based.

Donald (2002) says that psychologist should be more focused on mental processes rather than the gender differences. He says that gender schemes are created through social learning and a multiple of conditioning. Behavior, which is appropriate to the role, will be based on a number of factors, including cultural expectations, norms and stereotypes.

Cathy (1981) says that sex differences in socialization are associated with an economy that places a high premium on the superior strength and superior development of motors skills requiring strength, which characterize the male. Gender socialization does not stop at home, but continues in nursery elementary and later in high schools and colleges.

Fogelman (1961) reported no significant difference in the performance of boys and girls on conservation tasks. His research aimed at determining whether there was any significant difference if a group of children were randomly split into two groups and one group manipulated the conservation materials. This was called an “active” group. The group that watched at a distance was called “passive” group. The researcher found out that the overall performance of the two groups was similar. However, he noted that the boys did better under the “active” conditions and girls were superior under the “passive” conditions.

Kiminyo (1988) found out that girls tended to perform better than boys in the conservation of weight. He attributed the difference in performance of weight by boys and girls to environmental experiences. His explanation was that girls spent more time during their practical periods at school learning how to cook, which involved measuring different amounts of ingredients for cooking while boys got involved in activities that do not enhance the acquisition of cognitive ability of weight.

In another study, done in Nairobi by Kiminyo (1988) about conservation of numbers and mass, he found that boys performed slightly better than girls, though the performance was not significant. The explanation given was that the activities and games that boys engaged in influenced their slightly better cognitive tasks performance. Boys played with sticks, stones, and therefore, were likely to develop these concepts earlier than girls.

2.4 Cross cultural studies on intellectual achievement

Kiminyo (1988) and Brainerd (1978) argue that many cross-cultural intellectual studies done aimed at either validating or nullifying Piaget's theory of cognitive development. However, they note that most studies done are in close agreement to his findings. Hyde (1970) says that the studies on conservation of mass are popular among psychologists because of the simplicity of materials used and ease of the administration. He further notes that most materials used on conservation tests are also suitable for cross cultural studies, and therefore one can kill two birds with one stone.

Kiminyo (1991) in his thesis reported that Meru children of Tanzania lag behind on conservation of volume. The subjects were schooled and unschooled children who ranged from eight to fourteen years. The study aimed at determining the ages at which conservation of substance, weight and volume were acquired. He went on to report that Swiss children conserved substance by age seven while Meru children acquired it between age eight and nine. Swiss children conserved weight by age ten and nine compared to Meru children who conserved by age eleven. Meru children conserved it by the age of fourteen years. This study confirmed Piaget's statement concerning the invariant order of conservation of substances, weight and volume.

A study done in Zambia found out that, children above eleven years old could only achieve 55-60% conservation level (Kiminyo 1988). Even non-conservation among adolescents and adults was noted. The differences in performance of cognitive tasks by children of different cultures were caused by the environment and not genetic. Another factor to be considered in cross-cultural studies are the instruments used, for they may be culturally biased. Kiminyo (1988) further says that it is a futile exercise to assess cognitive growth across and within cultures using the same instruments unless one is sure that children in those cultures go through similar experiences.

John, David and Hellen (1985) say that among the adolescents and adults in non-western cultures, the formal operations stage seems to be even less frequently achieved.

3. Thematic Discussions

The objective of the research was to investigate the influence the school environment, age and culture can have on the children's cognitive tasks performance. It aimed at comparing the pupils' performance on some Piagetian cognitive tasks. Presentation in this chapter is done under for broad headings, namely:

- Cognitive task of conservation of length
- Cognitive task of continuous conservation of substance
- Cognitive task of conservation of mass and
- Cognitive task of conservation of volume

The categories of pupils compared were:

- 8 years old boys and girls.
- 10 years old boys and girls.
- 8 years old pupils in public and private primary schools.
- 10 years old pupils in public and in private primary schools.
- 10 years old pupils and 8 years old pupils.

4. Profile of the respondents

In order to achieve the above stated objectives, 333 pupils were orally interviewed from public and private primary schools. 8 primary schools were sampled out of 26 in Igembe central division, Igembe district. Out of those eight primary schools, four were public while the other four were private. Tables 4.1 and 4.2 below show the demographic data of the respondents. They show the distribution of sampled pupils according to their age, type of school and their gender.

Table 4.1: Number of pupils according to age and type of school

	Primary schools			
Age (in years)	Public	Private	Total	%
8	84	80	164	49
10	85	84	169	50
Total	169	164	333	100

49% of them were 8 years old while 50 % of those interviewed were 10 years old. 169 boys and 164 girls were involved in the study as table 4.2 below shows

Table 4.2: gender and age of the pupils

Gender	8 years		10 years		Total	
	Number	%	Number	%	Number	%
Boys	81	49	88	52	169	51
Girls	83	51	81	48	164	49
Total	164	100	169	100	333	100

52% of 10 years old pupils involved in the study were boys while 48% were girls. 49% of 8years old pupils involved in the study were boys while 51% were girls, irrespective of the type of primary schools they were drawn from. All 333 pupils orally interviewed responded to all the cognitive tasks given by the researcher. This became possible because the researcher conducted the research himself and each subject was interviewed individually.

4.1 Cognitive task on conservation of length

Each pupil was shown two straightened identical threads that were of the same length. After one of them was coiled, then the pupil was asked to state whether they are of the same length. 41% of the total number of pupils realized that coiling did not make it shorter than the straightened one. 59% of the pupils stated that the straightened thread was longer and therefore they were regarded has lacking cognitive ability of conservation of continuous length. The cognitive task was further analyzed according to gender, age and the type of school of the pupils.

4.2 Gender and age as a factor in conservation of length

Out of 164 girls who participated in the study, 35% had the cognitive ability of conservation of continuous length, that is, they stated that the two threads had the same length, While 65% failed to show the cognitive ability of conservation of continuous length. 48% out of 169 boys who participated, responded correctly about the length of two threads, and 52% failed to show the cognitive ability of conservation of continuous length. The table below shows the number of pupils in terms of the gender and age who conserved and those who failed to conserve the cognitive task of length.

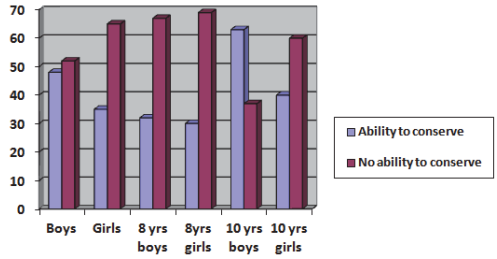
Table 4.3: pupils' performance on cognitive task of length as per age and gender

Age	Had ability to conserve		Had no ability to conserve		Total
	Number	%	Number	%	
8 years (both girls and boys)	51	31	114	69	164
8years old girls	25	30	58	70	83
8 years boys	26	32	56	68	82
10 years boys and girls	87	52	81	48	168
10 years girls	32	40	49	60	81
10 years old boys	55	63	32	37	87

32% of boys who were 8 years old responded correctly as compared to 30% of girls of the same age who responded correctly. 63% of boys who were 10 years old got the concept right as compared to 40% of girls who were also 10 years and who responded correctly. Clearly, more boys than girls of the same age performed better in this cognitive task of conservation of continuous length.

31% of all 8 years (irrespective of school) showed the ability of conservation of length compared to 52% of pupils who were 10 years old. This clearly shows that the age difference of only two years is making a noticeable difference. The table and bar graph below summarizes the pupils' cognitive tasks performance on conservation of continuous length based on gender and age.

Figure 4.1: Comparison of pupils' performance on conservation of length based on gender and age.



Despite the fact that the two groups were in the same stage of concrete operation, the difference in two years had made a big difference in performance of cognitive task on length. Comparatively boys performed far much better than girls, as illustrated by the bar graph above.

4.3 School environment as a factor in conservation of length

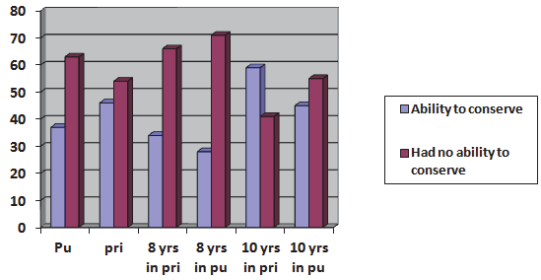
46 % pupils who were 8 and 10 years in private primary schools responded correctly to the cognitive task of length while 37% from public primary schools responded correctly. 33% of 81 pupils who were 8 years old from private primary schools showed the cognitive ability to conserve the length as compared to 29 % of 84 pupils who were of the same age from public primary schools. 59 % of 83 pupils who were 10 years old from private primary schools had the cognitive ability to conserve length as compared to 45% of 85 pupils who were of the same age from public primary schools. The school environment has some influence on the pupils' ability to conserve length, as the data demonstrates. The table below compares the private and public primary schools pupils' performance on the cognitive task of length.

Table 4.4: public and private primary school pupils' performance on cognitive task of length.

Age and school type	Had ability to conserve (%)	Had no ability to conserve (%)	Total
8 years old in private school	33	67	100
8 years old in public schools	29	71	100
10 years old in private	59	41	100
10 years old in public schools	45	55	100

The bar graph below farther illustrates the difference in performance of pupils based on the school environments. The difference in performance among the 8 years old pupils in private and public primary schools is not as big as the difference in performance of 10 years old pupils among public and private primary schools.

Fig. 4.2: Comparison of pupils performance from private and public primary schools on conservation of length



4.4 Cognitive task on continuous conservation of substance

The cognitive ability of conservation of substance was investigated by filling up two identical boiling tubes with water, and

then transferring water in one of them into a 250ml conical flask. The subject was asked to state the container with more water. Those who pointed out that the two containers had the same amount of water because the water in the bigger container was from the boiling tube, were regarded to having the cognitive ability of continuous conservation of substance. This is because they realized that pouring water from a small container to a bigger one did not change its amount. 44% pupils out of the total 333 pupils interviewed responded correctly in contrary to 56% who asserted that the boiling tube contained more water than the conical flask, apparently because it was taller, and consequently, they were regarded as lacking the cognitive ability of conservation of substance.

Table 4.5: Performance of pupils on conservation of continuous substance

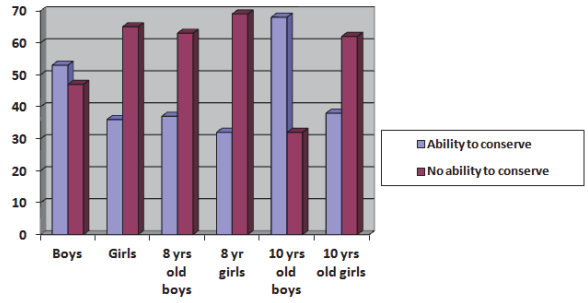
Age and gender	Had ability to conserve		No ability to conserve		Total	
	Number	%	Number	%	Number	%
8 both G & B) in both Pri and Pu	56	34	108	66	164	100
10 both G & B	90	53	79	47	169	100
8 in pri both B & G)	29	36	52	64	81	100
8 in pu (both B & B)	27	32	57	68	84	100
10 in pri both G % B	51	61	32	39	83	100
10 in pu both G & B	39	46	46	54	85	100

Keys: B - Boys; G - Girls

4.5 Gender and age as a factor in conservation of continuous substance

Out of 169 boys who were interviewed, 53 % responded correctly while 35 % of 164 girls interviewed realized that transferring water from a small container to a bigger container did not increase nor reduce its quantity. 47% of boys had no ability to conserve substance in comparison to 65% of total number of girls who failed to conserve substance. 36 % of boys who were 8 years old responded correctly compared to 31% of girls who were of the same age. 68% of boys who were 10 years old had the ability to conserve the substance compared to 38% girls of the same age. More boys showed the ability to conserve substance as compared to girls. 34 % of 8 years old pupils had the cognitive ability of conservation of substance compared to 53 % of 10 years old pupils. 64 % of 8 years old pupils asserted that the boiling tube contained more water than the conical flask, while 47% of the older pupils 10 years also failed to conserve substance. As illustrated above, gender and age influence the achievement of ability to conserve substance in children of between 8 and 10 years. The bar graph below shows the performance of pupils on cognitive task of substance based on gender and age.

Fig 4.3: comparison of pupils' performance on conservation of continuous substance based on gender and age

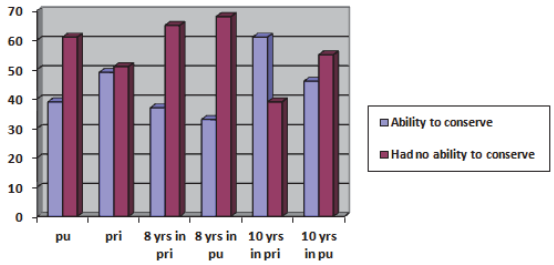


4.6 School environment as a factor in conservation of continuous substance

49 % of pupils in private primary schools who were both 8 and 10 years responded correctly i.e. they realized that mere transferring from a smaller container to a bigger one could not have altered the amount of water. 39% of pupils in public primary schools who were also 8 and 10 years responded correctly. In comparison, pupils in private primary schools performed better than pupils in public primary schools, showing that school environment has some influence on the cognitive task of conservation of substance.

Comparing further on the basis of age of boys and girls in both private and public primary schools, the following information was collected. 36% of the pupils who were 8 years in private primary schools had the ability to conserve substance while 32% of the pupils in public primary schools of the same age showed the ability to conserve substance. 61% of 10 years old pupils in private primary schools responded correctly compared to 46% of pupils of the same age in public primary schools. The bar graphs below compare pupils' performance on conservation of substance from two different school environments.

Fig 4.4: Comparison of pupils' performance from private and public primary schools on conservation of substance.



4.7 Cognitive tasks on conservation of mass

The pupils' performance on cognitive task of conservation of continuous mass was investigated using a "ball" of plasticine. The subject was involved in making the ball of plasticine that was divided into two equal spherical balls. After the pupil agreed that the two balls were equal in all aspects, one of them was then divided into four smaller balls and the subject asked to state the one that contained more plasticine, the big ball or the four small balls. The one, who stated that the big ball and the four small balls had the same amount of plasticine, was regarded as having the cognitive ability of continuous conservation of mass. 20% out of 333 pupils responded correctly, while 80% pointed out that the four smaller balls contained more plasticine, and consequently, they were considered as lacking the cognitive ability of conservation of mass. The table below summarizes the researcher's analysis of pupils' performance on the cognitive tasks of mass.

Table 4.6: Performances of pupils on conservation of mass

Age in years	Gender	Type of school	Ability to conserve		Had no ability to conserve		Total
			Pupils	%	Pupils	%	
8	Both	both	18	11	146	89	164
10	Both	both	48	28	121	72	169
8	Both	Private	11	14	70	86	81
8	Both	Public	7	8	77	92	84
10	Both	Private	32	39	50	61	82
10	Both	Public	15	18	70	82	85
8 and 10	Boys	both	42	25	127	75	169
8 and 10	Girls	both	24	15	140	85	16

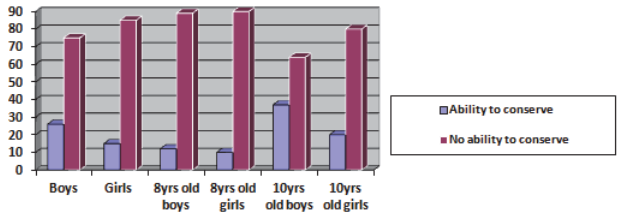
4.8 Gender and age as a factor in conservation of mass

25% and 15% boys and girls respectively of ages 8 and 10 years old responded that the amount of plasticine was the same irrespective of the transformations of shape and subdivisions of the plasticine ball, as long as the initial amount was not altered. 85% girls said that the four small balls contained more plasticine compared to 75% boys who responded similarly and therefore they were regarded as lacking the cognitive ability of continuous conservation of mass. More girls were unable to realize that dividing a substance, does not alter its mass. 12% boys who were 8 years old responded correctly compared to 10% girls of the same age. The age difference of only two years had influence on the pupils' performance of cognitive task of conservation of continuous mass because 37% of boys who were 10 years old got it right compared to 12% of boys who were two years younger. This was repeated to girls since those who were 10 years old performed better (20%) than girls who were 2 years younger (10%).

Generally this task was poorly performed by both boys and girls, for example 8 years old pupils irrespective of their gender and type of school, it was only 11% who showed the cognitive ability to conserve mass, while only 29% of boys and girls who were 10 years old had shown this ability. 89% and 71% of pupils who were 8 and 10 years respectively pointed out that four small balls contained more plasticine, and hence they were regarded as lacking the cognitive ability of continuous mass.

The bar graph below compares the pupils' performance on cognitive task of mass based on gender and age.

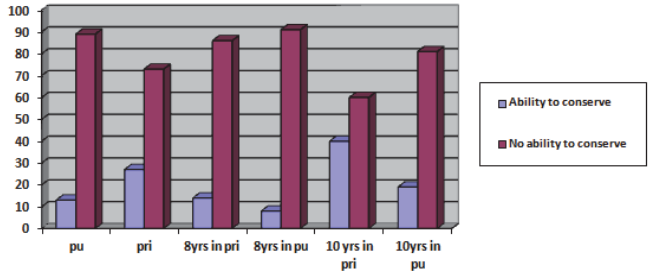
Fig 4.5: comparison of pupils' performance on conservation of mass based on gender and age.



4.9 School environment as a factor in conservation of mass

Mass is the amount of content the matter contains. The pupils were expected to reason that the content of plasticine would remain constant irrespective of the number of subdivisions done as long as the initial content remains the same. The school environment had influence on the performance of this cognitive task because. 27% of all the pupils interviewed in private primary schools responded correctly compared to 13% from public primary schools. In addition, 14% of the pupils who were eight years old in private primary schools responded correctly in comparison to 8% of pupils in public primary schools who were of the same age. 40% of the pupils in private primary schools of 10 years old responded correctly compared to 18% from public primary Schools, who were of the same age. The bar graph below summarizes the comparison of pupils' performance from public and private primary schools.

Fig. 4.6: Comparison of pupils' performance from private and public primary school on conservation of mass.



4.10 Cognitive task on conservation of volume

Two containers of the equal volume but of different shapes (Cuboid and cylindrical) were made. Each pupil at a time was asked to fill up one of the said containers with grains and transfer them to the other container. When the subject agreed with the researcher that the two containers were filled up by the same amount of grains, then the grains were emptied into another container. The pupil was asked to observe keenly the two empty containers and then asked to point out at the one that would contain more sand. The one, who responded that both containers would contain the same amount of sand since they had been filled up with the same amount of grains, was regarded as having the cognitive ability of conservation of continuous volume. 22% of all the total pupils interviewed responded that both containers would contain the same amount of sand, while 78% of the pupils pointed out that the cylindrical container would hold more sand, apparently because it was the one seemed bigger due to its height. This cognitive task required the respondent to reason deductively, in that the volume occupied by the grains would be the same to be occupied by the sand irrespective of the

height of the container. The table below is a summary of the research findings on this cognitive task of conservation of volume.

Table 4.7: performance of pupils on conservation of volume

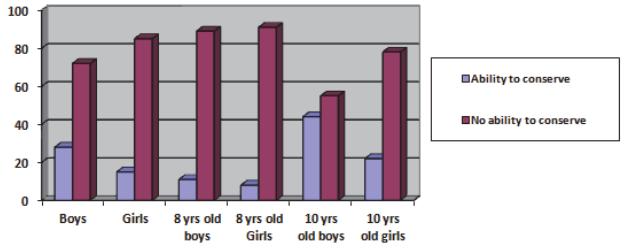
Age	Gender	Type of school	Had ability to conserve		Had no ability to conserve		Total No. of pupils
			pupils	%	pupils	%	
8	Both	both	16	10	149	90	165
10	Both	both	56	33	112	67	168
8	Both	Private	9	11	72	89	81
8	Both	Public	7	8	77	92	84
10	Both	Private	40	48	43	52	83
10	Both	Public	16	19	69	81	85
8 and10	Boys	Both	47	28	122	72	169
8 and10	Girls	Both	25	15	139	85	164

4.11 Gender and age as a factor of conservation of volume

28% of boys who were 8 and 10 years old realized that the two containers would contain the same amount of sand compared to 15% of the girls of the same ages. 72% of the boys and 85% of the girls who were 8 and 10 years pointed out that the cylindrical container would contain more sand simply because it is taller than the cuboid container. The difference in performance was due to either one being a boy or a girl. This is because the compared performance is drawn from pupils of both private and public schools. To demonstrate the issue of gender further, the researcher analyzed the performance of boys and girls of the same age. 11% of boys who were 8 years old responded correctly compared to 8% of the girls of the same age. 48% of the boys who were 10 years old responded correctly compared to 22% of the girls of the same age. Apart from demonstrating the issue of gender difference in performance of cognitive task of conservation of volume, it also point out the role played by the biological maturation, because a difference of only two years is causing twice the difference in performance despite the fact that the subject were all in the same stage of concrete operation of Piaget's theory of intellectual development.

To illustrate the issue of age and make it even clearer, a comparison of girls to girls and boys to boys of different ages respectively was done. 44% of the boys who were 10 years old responded correctly on the task of volume compared to 11 % of the boys who were 8 years old. 22% of girls who were 10 years old responded correctly in comparison to 8% of the girls who were 8 years old. The bar graph below summarizes the pupils' performance on cognitive task of volume based on gender and age.

Fig 4.7: comparison of pupils' performance on conservation of volume based on gender and age.



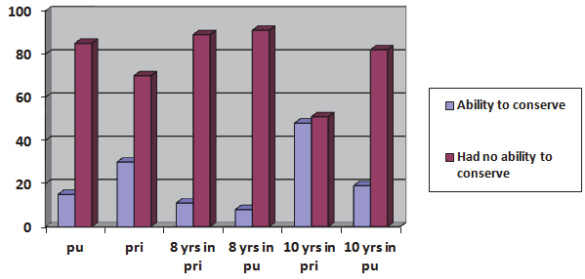
4.12 The School environment as a factor in conservation of volume

In order to find out if the school environment had any influence on the cognitive ability to conservation volume, the performance of pupils who learn in private primary schools were compared with those in public primary schools. 14% of the pupils in public primary schools interviewed responded correctly on the cognitive task on volume as compared to 30% of pupils in private primary schools. This means that 86% and 70% of pupils in public and private primary schools

respectively lacked the cognitive ability to conservation volume. Children in private primary schools performed comparatively better than those in public primary schools.

On farther analysis based on age, the researcher found out that, 11% pupils who were 8 years in private primary schools responded correctly compared to 8% of pupils of the same age in public primary schools. Those who were 10 years old in private primary schools had 48% responding correctly compared to 19% of the same age in public primary schools. The bar graph below summarizes the comparison of pupils' performance on the cognitive task of volume from public and private primary schools.

Fig.4.8: Comparison of pupils' performance from private and public primary schools on conservation of volume.



4.13 The trend in performance of pupils on the selected cognitive tasks

The trend in performance of those four cognitive tasks selected and administered to 333 pupils of 8 and 10 years is summarized on the bar graph below. The difference in performance of cognitive tasks among pupils of 8 years old is not as big as the difference in performance of cognitive tasks among pupils of 10 years. Take for example the performance of cognitive task on volume by 10 years old pupils in private and public primary schools; 48% pupils in private primary schools responded correctly compared to only 19% public primary schools, whereas 11% of 8 years old in private primary schools responded correctly compared to 8% pupils of the same age in public primary schools.

The influence of environment is more significant among pupils of 10 years than pupils of 8 years. The trend pupils' performance on the selected four selected cognitive task was that the task of length and substance was relatively well done in comparison to tasks of mass and volume.

The concept of length and substance was comparatively understood better in comparison to the concept of mass and volume by the pupils interviewed. This is in conformity of Piagetian theory of intellectual development that postulates that the concept of length is acquired first by children and the concept of volume is realized being the last. The idea of biological maturation is dispelled as the only factor that influences the acquisition of cognitive abilities. This is revealed by comparing the performance of pupils on cognitive tasks by private and public primary school pupils. The tale below is a summary of result of pupil on conservation of those four tasks.

Table 4.8: Pupils' performance on conservation of length, continuous substance, mass and volume.

Type of school	Pupils	Task on length (%)		Task on substance (%)		Task on mass (%)		Task on volume (%)	
		Yes	No	Yes	No	Yes	No	Yes	No
Private	164	46	54	49	51	27	73	30	70
Public	169	37	63	39	61	13	87	14	86

Key: Yes – had ability to conserve the specified task; No – failed to conserve the specified task

Piaget is sometimes misunderstood concerning his views on the roles of maturation and learning. It should be abundantly clear that Piaget is not a simple maturationist. He did not believe that the infant's development unfolds solely as a result of some kind of physical maturation. Piaget's position is that maturation has a role, but certainly is not the only factor in intellectual development and the effects of the environment are quite important and to this extent he is in agreement with the environmentalist (Ginsburg and Opper, 1969).

5. Conclusion

From the analysis of the data, the following conclusions were made:

- Pupils from private primary schools performed better than pupils from public primary schools in all those four cognitive tasks given.
  Learning environment of pupils contributes to better performance of cognitive tasks (private primary schools provides stimulating and conducive environment to learning compared to public primary schools). Otaalo (1970) in his thesis found out that, rural school children performed quite poorly on Piagetian tasks of length, mass and volume as compared to urban school children. Hetherington and Park (1979) wrote about studies done that had shown improvement in children's cognitive abilities in solving intellectual problems after experiencing some form of social interaction. Therefore social transmission-receiving information by reading books, receiving instructions from the teachers, imitation and motivation, could be another factor that could have contributed to the better performance of pupils from private primary schools than their counterparts in public primary schools.
- Boys performed better in all those four cognitive tasks given though the deference was not significant to generalize that boys are intellectually superior to girls.
- A two year difference of age made difference in performance in all those four cognitive tasks given despite the fact that all subjects were at concrete operational stage of intellectual development.
- Basic needs if not met disrupts pupils reasoning ability. The researcher found out that pupils in private primary schools take their meals in schools while their counterparts have to go home for their meals. From the look of the type of tattered uniform some of them were wearing, one would make a quick conclusion that quite a number of them missed lunch. Therefore lack of some basic needs, such as food, could have contributed to poor performance of cognitive tasks by pupils from public primary schools.

References

Barry H.K and Henry L.R (1984). *Experimental psychology* (2nd edition) Minesota. West Publishing Co.
Bernstain A. (1997), *Psychology* (4th Edition). New York, NY: Houghton Miffin.
Biehler F.R (1976), *Child development: An introduction*. London. Houghton Mifflin.
Blair, G.M (1968). Educational psychology (3rd edition). London Macmillan.
Bomstein, H.M and Lamb E.M (1988). *Developmental psychology*. *An advanced textbook* (2nd Edition). London. Lawrence Erbium Associates.
Brainerd, C.J (1978). *Piaget's theory of intelligence*. New Jersey, NJ: Prentice Hall
Carlson, R.N (1990). *Psychology. The science of behavior*. Boston. Allwn and Bacon.
Cathystein G. (1981). *An introduction to sociology*: New York. Alfred A. Knopt.
Cohen, S.S (1988). *Practical statistics*. Boston Edward Arnold.
Crain. C.W (1980). *Theories of Development: concepts and applications*. New Jersey. NJ prentice Hall
Darley M.J. (1984) *Psychology* (2nd edition). New Jersey NJ: Prentice Hall.
David E. And John H.F (1969). *Studies in cognitive development*. New York. Oxford University press.
Donald P. (2002). *Introducing Psychology*. London. Hodder and Stoughton.
Elkind, D (1961). *Children's discovery of conservation of mass, weight and volume: intellectual development.* New York NY: John Wiley.
Feldman S.R. (1999). *Understanding Psychology.* (5th Edition). New York, NY: McGraw-Hill
Fogelman K.R. (1969). *Piagetian Tests and sex differences*. New York, NY: Humanities.
Gail, D.M., Borg, R.W and Gall P.J (1996). *Educational research* (6th edition). New York NY: Longman.
Gazzaniga, S.M (1973), Fundamentals of psychology. New York, NY: Academic
Gerow R.J (1996). *Essentials of psychology*. New York, NY Harper Collins College.
Gisburg H and Opper S (1969). *Piaget's theories of intellectual development. An introduction*. New York NY: Mc Graw-Hill
Hebb, D.O (1972). *Textbook of psychology*. London. Sounders.
Hetherington, A & Park, B (1979). *Child Psychology. A contemporary viewpoint*. New York, NY: MC Graw –Hill.
Hyde, D.M.G (1970). *Piaget and Conceptual development*. London: Holt Rinehart and Winston.
Ingule, F. (1996). *Introduction to educational psychology*. Nairobi East African Educational.
Inhelder, B. (1968). *The diagnosis of reasoning in the mentally retarded children*. New York, NY: John Day.
Jay F and Gordon S, (2006). *Cognitive Science*. London sage Publications.
John P.H Hellen B & David C.R (1983) Introduction to psychology. New York Academic press
Keiss H.O and Blooquist D.W (1985). *A conceptual Approach*. Boston. Allyn and Bacon.
Kimamo, C.O.N. (1991). *Intellectual development in normal and mental retarded children in integrated systems of education in Kenya*. Unpublished M.Ed. thesis. Kenyatta University, Nairobi

Kiminyo, M.D. (1988). General psychology of education Nairobi. Education Research and publication Co.
Kothari, R.C (1970). Research methodology (2nd edition). New Delhi. Willy Eastern.
Liebert M.R. & Rita W.N (1981). *Developmental psychology* (3rd edition). New Jersey J.S: Prentice-Hall
Lovell K. (1961). *The growth of basic mathematical and scientific concepts in Children.* London. University of London.
Marc, H.B and Michael E.L (1988). *Developmental psychology. An advanced textbook.* (2rd edition). London, Lawrence Erlbaum.
McFarland, (1971). *Psychology. Theory and practice*. London. Routledge and Kegan. Mifflin.
Mugenda, O & Mugenda, G (1999). *Research Methods: Qualitative and Quantitative Approaches*. Nairobi, Kenya: Africa Centre Technology studies.
Mutahi K.B (2000): How to write quality research proposal. New York, Thelley publication.
Mwangangi, R.J (1974). *The cognitive development of Kenya African children as shown by their performance on selected Piagetian tasks of conservation*. Unpublished Ph.D. Thesis, University of Michigan.
Ndambuki P.W (1987). *Kenya' Young People's Stereotypic view of handout occupational roles.* Unpublished Ph.D. Thesis. Kenyatta University, Nairobi.
Nyiti, R.M (1973). *Intellectual in the Meru children of Tanzania*; Unpublished Ph.D. Thesis. Michigan MI: Ann Arbov.
Opper, S (1972). *Intellectual development in Thai Children*. Unpublished Ph.D. Thesis, Cornell University. New York.
Orodho A.J (2005). *Education and social science research methods*. Nairobi
Orodho A.J (2005). *Techniques of writing research proposals and report in education and social sciences.* (2nd edition). Nairobi. Kanejza HP Enterprises.
Otaala B. (1970). *Conservation, seriation and classificatory abilities of Iteso primary school children*. Unpublished M.Ed. Thesis, Makerere University, Kampala.
Pulaski, M.A. (1969). *Understanding Piaget*. New York NY: Harper and Row.
Ripple R. (1982). Human development Boston Houghton Mifflin Co.
Salkind NJ (1985). *Theories of human development*. New York. John Wiley and Sons.
Seifert L.K (1991) Educational psychology (2nd edition) . New Jersey. Houghton
Seigel L.S & Brainerd C.F (1978). *Alternative to Piaget Critical and theory.* New York, NY Academic.
Wangari E. (1982). *Conservation of number, length, mass and seriation among kikuyu pre-primary school children aged 4-6 years*. Unpublished M.Ed. thesis, Kenyatta University, Nairobi.
William N.D James J & Timothy J.T (1984). *General psychology*. New Jersey. Lawrence Erlbaum Associated publishers.
Winfred F.H. (1970). *Psychology* New York. Lippincort Co.