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An Investigation into Liquid Conservation Ability Among Primary Schools Children at District Nowshera to Test Piaget's Theory of Cognitive Development

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Abstract: The research was purposed to test the "Piaget's Theory of Cognitive Development" while investigating into the liquid conservation ability of rural and urban primary school students at District Nowshera. The main objectives of the research are to study the liquid conservation ability of girl's students at primary level ranging from 6 to 10 years age group; to compare the liquid conservation ability of urban and rural girls students at primary level and those of government and private schools students. Certain null hypotheses have been tested to achieve the aforementioned objectives. A sample of 200 girl's primary school children of district Nowshera, Khyber Pakhtunkhwa has been investigated. An empirical research design was used, and data collection was done through observation sheets. Statistical techniques such as t-test and descriptive statistics were utilized for data analysis. Students at primary level ranging from 6 to 7 years age group found to be not liquid conservers in all the cases, while majority of the students at primary level ranging from 8 to 10 years age group found to be liquid conservers. Children' liquid conservation ability thus confirmed to be increasing with age enhancement. Urban and rural students at primary level performed almost same but urban private students found to be comparatively better than those of rural area.

Key words: Cognitive development, Liquid conservation, Descriptive statistics.

1. Introduction

Education is the yardstick through which the mental growth of children can be measured. This is one of the foremost roles being played by education. Problem solving, logical perceptive and inventive thinking are all essential abilities obligatory for existence. These thinking skills should be developed during the time at school from primary to secondary level being the most pertinent years of a person's cognitive development.Primary education comprising grades one to five builds up the foundation of a child. Curriculum includes language skills, basic Mathematics, Science and Social studies, Islamic philosophy and physical health training[1]. The role of education Instructors is very significant in the cognitive developmentof students mainly primary school

students, especially in their personality development thus helping them become successful citizens of the nation. The term development includes the physical, social, emotional, moral and cognitive aspects. Cognitive development plays a significant role in students' learning process.Piaget theory of cognitive development along with its stages plays a guiding role in the research being conducted on the cognitive development in various countries of the world. Conservation means, "if we change the place of physical object, it will not affect its length, quantity or number of that particular item". Research has been conducted on various conservation tasks such as "*Conservation of number, length, area, amount of substance, weight, quantity and liquid volume*".Jean Piaget has conducted research mainly on the development of children's thinking and mentioned cognitive development as hierarchical and contingent on age. According to Jean Piaget, children's thinking passes through well-defined stages i.e. "from sensory-motor (0 to 2 years) to formal operational thought (11 to 19 years)". The studies conducted by Piaget resulted that a smaller number of children found to be at the more developed stages of thought, thus not showing thinking skills having higher order.

Teachers having familiarity with the intellectual stages of their students can better handle them with provision of learning materials and adopting teaching learning process while keeping into account their mental level. According to Piaget, the cognitive development is consisted of three stages i.e. *sensory-motor, concrete operational and formal operational.*

1.2. Research Objectives

Objectives of the study are listed below:

1. To compare the liquid conservation ability of urban and rural girls' primary school children.
2. To compare the liquid conservation ability of government and private girls' primary school children.

1.3. Hypotheses

The following null hypotheses have been developed to achieve the aforementioned objectives:

$H_0$1:The liquid conservation ability of urban and rural girls' primary school children has no significant difference.
$H_0$2:The liquid conservation ability of government and private girls' primary school children has no significant difference.
$H_0$3:The liquid conservation ability of urban government and private girls' primary school children has no significant difference.
$H_0$4:The liquid conservation ability of rural government and private girls' primary school children has no significant difference.
$H_0$5:The liquid conservation ability of urban government and rural government girls' primary school children has no significant difference.
$H_0$6:The liquid conservation ability of urban private and rural private girls' primary school children has no significant difference.
$H_0$7:The liquid conservation ability of urban government and private and rural government and private girls' primary school children has no significant difference.

2. Literature Review

Mullin (2004) [2] conducted his research study on "Development of Conservation of Liquid in Preschool Children". The study was purposed to determine the sense of development of liquid conservation among children during the age range of 3, 4 and 5 years. The sample consisted of thirty children i.e. ten each of 3 years old, 4 years old and 5 years old. Data in regard to the aforementioned groups found to be falling into two categories i.e. "*overall scores"* (comparing same volumes of liquid in identical containers) and "*conservation scores"* (comparing same volumes of liquid in containers having different shape and appearance). Resultantly on the overall score, 4 years old children found to be slightly higher than 3 years old and those of 5 years old showed higher significance as compared to 4 years old or 3 years old. As per the conservation scores, 3 years old and 4 years old children found to be identical, while those of 5 years old proved to be slightly higher as compared to the younger groups. Jehan and Butt (2014)[3]while conducting a research study on "attainment of conservation ability among primary school children in the light of Piaget's Cognitive Theory" revealed that education is responsible for bringing along constructive and positive changes in the personality of an individual

as per his surroundings. The study resulted that rural school children proved to be showing slightly better performance than urban school students.Watanabe (2017) [4] examined the Piaget's concept of development of conservation in his study while focusing on "certain conservation concepts like number, length, and liquids" in relation to toddlers. The study resulted in demonstrating the possibility of 3 years old child's learning of Piaget's concept of conservation while making the toddler familiar with the task. The research involving the children into Piaget's conservation tasks through playful activities resulted in positive effects.

3. Method and Procedure

3.1. Population

The research population comprised all 1,361,902 (1.361 million) girls' primary school children that is government and private Khyber Pakhtunkhwa[5].

3.2. Sample

One hundred (100) schools each from urban and rural areas have been made part of the research study out of which fifty (50) schools each from Government and Private sectors have been selected. While using convenient sampling method, two (2) schools have been selected each from "*urban government girls' primary schools*, *urban private girls' primary schools*, *rural government girls' primary schools, and rural private girls' primary schools".* Fifty (50) students (5 each from 6 to 10 years) have been randomly selected. Following this method, 200 students have been observed to conduct the Piaget's conservations tasks in order to test their liquid conservation ability.Diagrammatic representation of population and sample is highlighted below:

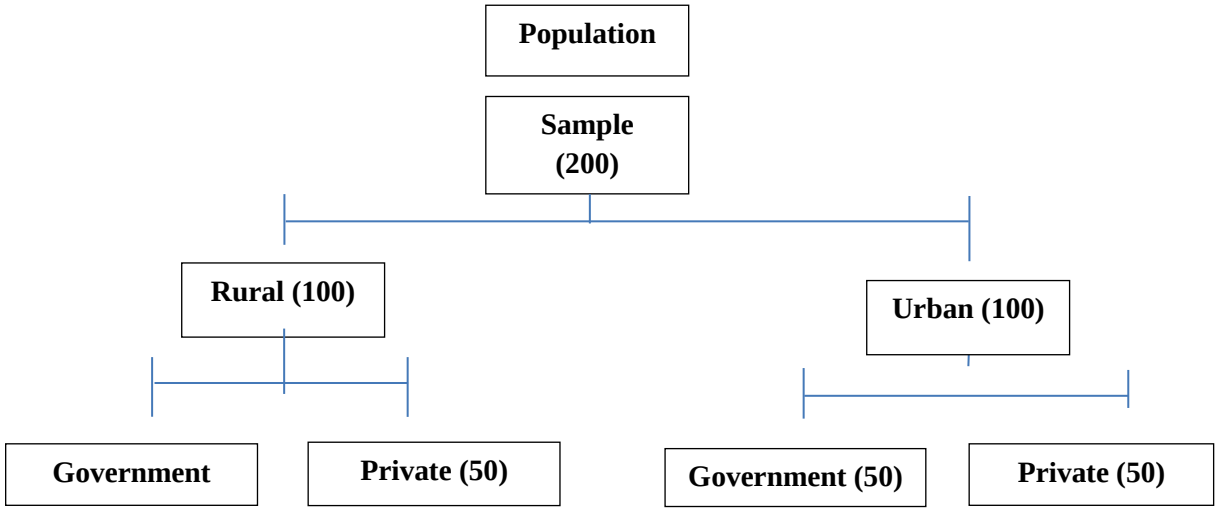

Figure 1

3.3. Research Instruments

Two congruent cylindrical containers (A, B) have been used for the experiment.

3.4. Research Study Procedure

The Piaget's conservation task in regard to liquid was conducted in the following way:

Task 1
The students under study have been presented two cylindrical containers (i.e. A, and B) of same size, containing the same amount of water, have been placed side by side, and the student has been asked:
1. Is there the same amount of water in these two containers?
2. If the answer is 'Yes' or 'No', then why?

Task 2

Then the water in container **B** has been shifted to a tall thin container **C** and the student has been asked for comparison of containers **A** and **C**. The student has been asked:

1. Whether the water in the new container has the same quantity as in A, using questions like "Which one contains more water?" The same question is repeated.
2. If the answer is 'Yes' or 'No', then why?

4. Data Analysis and Interpretation

Data analysis and interpretation was done while using t-test.

A. Area/Region wise Comparison of Liquid Conservation Ability of Children

Table 1: Liquid conservers (6-10 years old) belonging to urban and rural girls' primary schools

Group	N	Age	Conservers	df	T
Urban	20	6 years	0	38	0
Rural	20		0		
Urban	20	7 years	5	38	0.776
Rural	20		3		
Urban	20	8 years	12	38	1.259
Rural	20		8		
Urban	20	9 years	16	38	0.717
Rural	20		14		
Urban	20	10 years	20	38	0
Rural	20		20		

The above table depicts that the t-values (0, 0.776, 1.259, 0.717 and 0) of urban and rural girls having age group of 6 to 10 found to be non-significant at 0.05 level leading to acceptance of the null hypothesis. No significant difference found to be there in the frequency of 6 to 10 years old urban and rural girls' primary school liquid conservers.

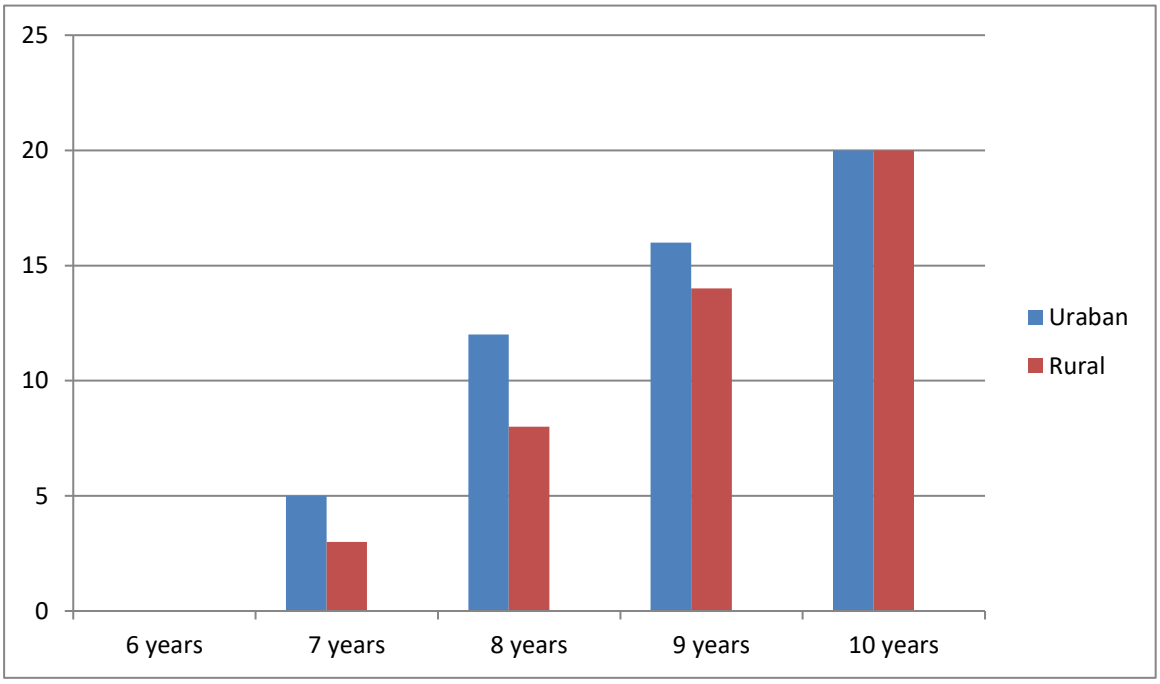

Figure 2: Area/Region wise Comparison of Liquid Conservation Ability of Children

B. Structure wise Comparison of liquid Conservation Ability of Children

Table 2: Liquid conservers (6-10 years old) belonging to government and private girls' primary schools

Group	N	Age	Conservers	Df	t
Government	20	6 years	0	38	0
Private	20		0		
Government	20	7 years	4	38	0
Private	20		4		

Government	20	8 years	10	38	0
Private	20		10		
Government	20	9 years	14	38	0.717
Private	20		16		
Government	20	10 years	20	38	0
Private	20		20		

The above table depicts that the t-values (0, 0, 0, 0.717 and 0) of government and private girls having age group of 6 to 10 found to be non-significant at 0.05 level leading to acceptance of the null hypothesis. No significant difference found to be there in the frequency of 6 to 10 years old government and private girls' primary school liquid conservers.

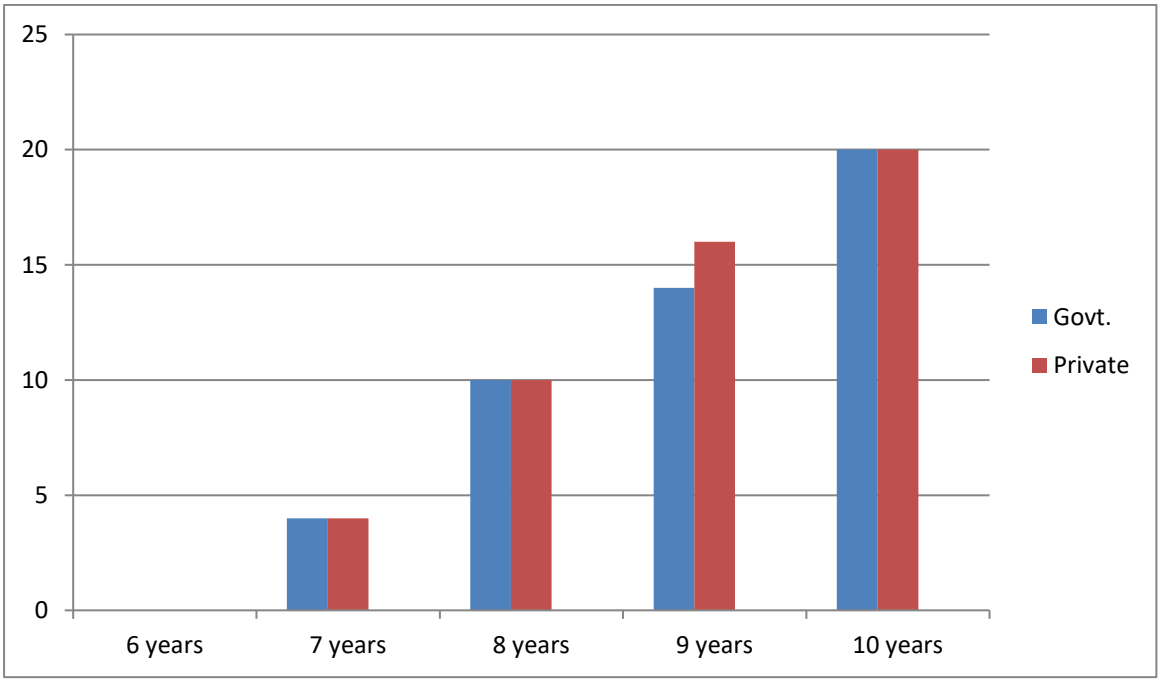

Figure 3: Structure wise Comparison Of liquid Conservation Ability of Children

C. Comparison of Children's Liquid Conservation Ability of Urban Government and UrbanPrivate Schools

Table 3: Liquid conservers (6-10 years old) belonging to urban government and urban private girls' primary schools

Group	N	Age	Conservers	df	T
Urban Govt	10	6 years	0	18	0
Urban Private	10		0		
Urban Govt	10	7 years	3	18	0.493
Urban Private	10		2		
Urban Govt	10	8 years	6	18	0
Urban Private	10		6		
Urban Govt	10	9 years	8	18	0
Urban Private	10		8		
Urban Govt	10	10 years	10	18	0
Urban Private	10		10		

The above table depicts that the t-values (0, 0.493, 0, 0, and 0) of urban government and private girls having age group of 6 to 10 found to be non-significant at 0.05 level leading to acceptance of the null hypothesis. No significant difference found to be there in the frequency of 6 to 10 years old urban government and private girls' primary school liquid conservers.

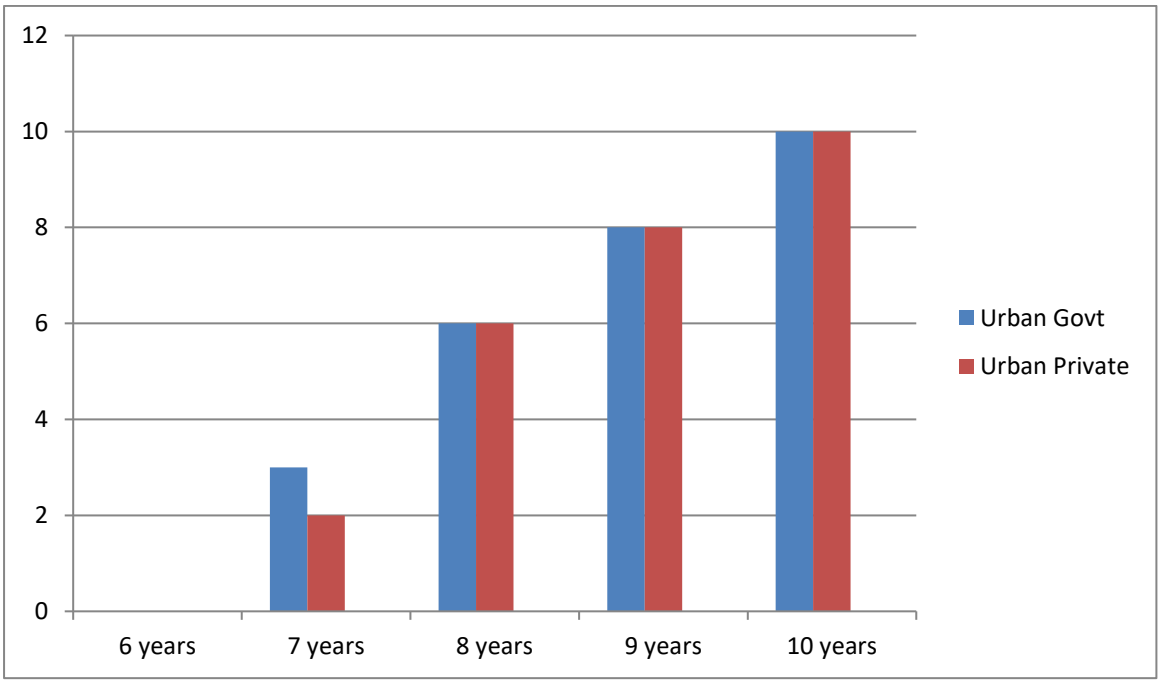

Figure 4: Comparison of Children's Liquid Conservation Ability of Urban Government and Urban Private Schools

D. Comparison of Children's Liquid Conservation Ability of Rural Government and Rural Private Schools

Table 4: Liquid conservers (6-10 years old) belonging to rural government and rural private girls' primary schools

Group	N	Age	Conservers	df	T
Rural Govt	10	6 years	0	18	0
Rural Private	10		0		
Rural Govt	10	7 years	1	18	0.599
Rural Private	10		2		

Rural Govt	10	8 years	4	18	0
Rural Private	10		4		
Rural Govt	10	9 years	6	18	0.948
Rural Private	10		8		
Rural Govt	10	10 years	10	18	0
Rural Private	10		10		

The above table depicts that the t-values (0, 0.599, 0, 0.948, and 0) of rural government and private girls having age group of 6 to 10 found to be non-significant at 0.05 level leading to acceptance of the null hypothesis. No significant difference found to be there in the frequency of 6 to 10 years old rural government and private girls' primary school liquid conservers.

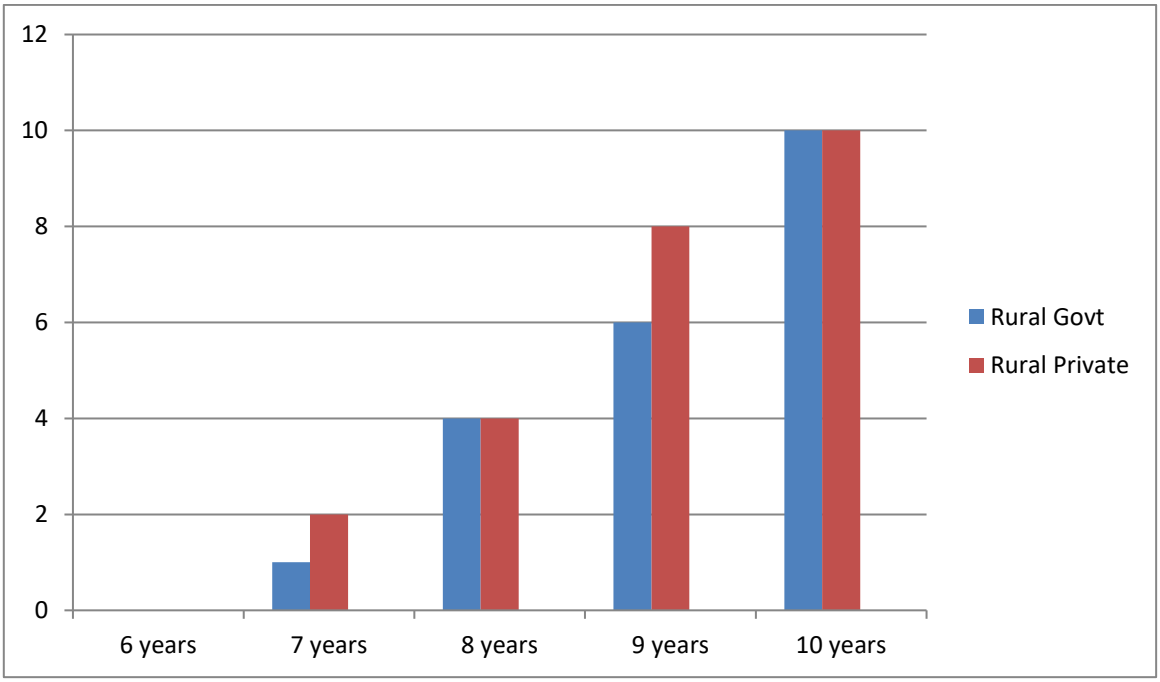

Figure 5: Comparison of Children's Liquid Conservation Ability of Rural Government and Rural Private Schools

E. Comparison of Children's Liquid Conservation Ability of Urban Government and Rural Government Schools

Table 5: Liquid conservers (6-10 years old) belonging to urban government and rural government girls' primary schools

Group	N	Age	Conservers	df	t
Urban Govt	10	6 years	0	18	0
Rural Govt	10		0		
Urban Govt	10	7 years	3	18	1.095
Rural Govt	10		1		
Urban Govt	10	8 years	6	18	0.866
Rural Govt	10		4		
Urban Govt	10	9 years	8	18	0.948
Rural Govt	10		6		
Urban Govt	10	10 years	10	18	0
Rural Govt	10		10		

The above table depicts that the t-values (0, 1.095, 0.866, 0.948, and 0) of urban and rural government girls having age group of 6 to 10 found to be non-significant at 0.05 level leading to acceptance of the null

hypothesis. No significant difference found to be there in the frequency of 6 to 10 years old urban and rural government girls' primary school liquid conservers.

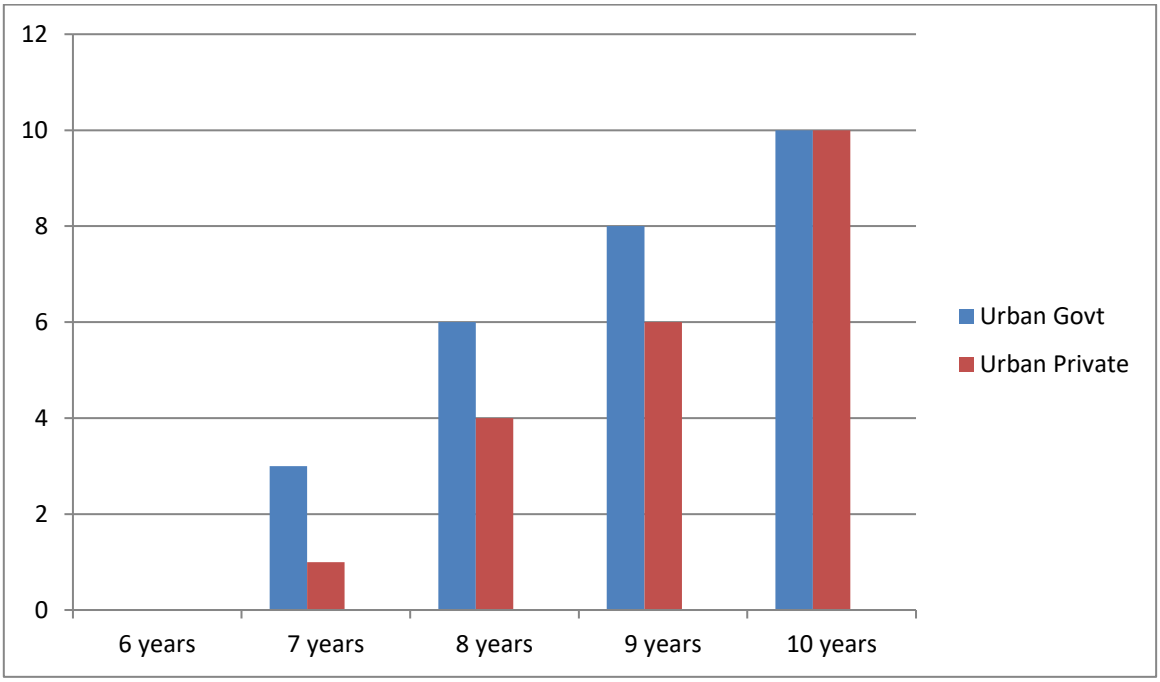

Figure 6: Comparison of Children's Liquid Conservation Ability of Urban Government and Rural Government Schools

F. Comparison of Children's Liquid Conservation Ability of Urban Private and Rural Private Schools

Table 6: Liquid conservers (6-10 years old) belonging to urban private and rural private girls' primary schools

Group	N	Age	Conservers	df	t
Urban Private	10	6 years	0	18	0
Rural Private	10		0		
Urban Private	10	7 years	2	18	0
Rural Private	10		2		
Urban	10	8 years	6	18	0.866

Private					
Rural Private	10		4		
Urban Private	10	9 years	8	18	0
Rural Private	10		8		
Urban Private	10	10 years	10	18	0
Rural Private	10		10		

The above table depicts that the t-values (0, 0, 0.866, 0, and 0) of urban and rural private girls having age group of 6 to 10 found to be non-significant at 0.05 level leading to acceptance of the null hypothesis. No significant difference found to be there in the frequency of 6 to 10 years old urban and rural private girls' primary school liquid conservers.

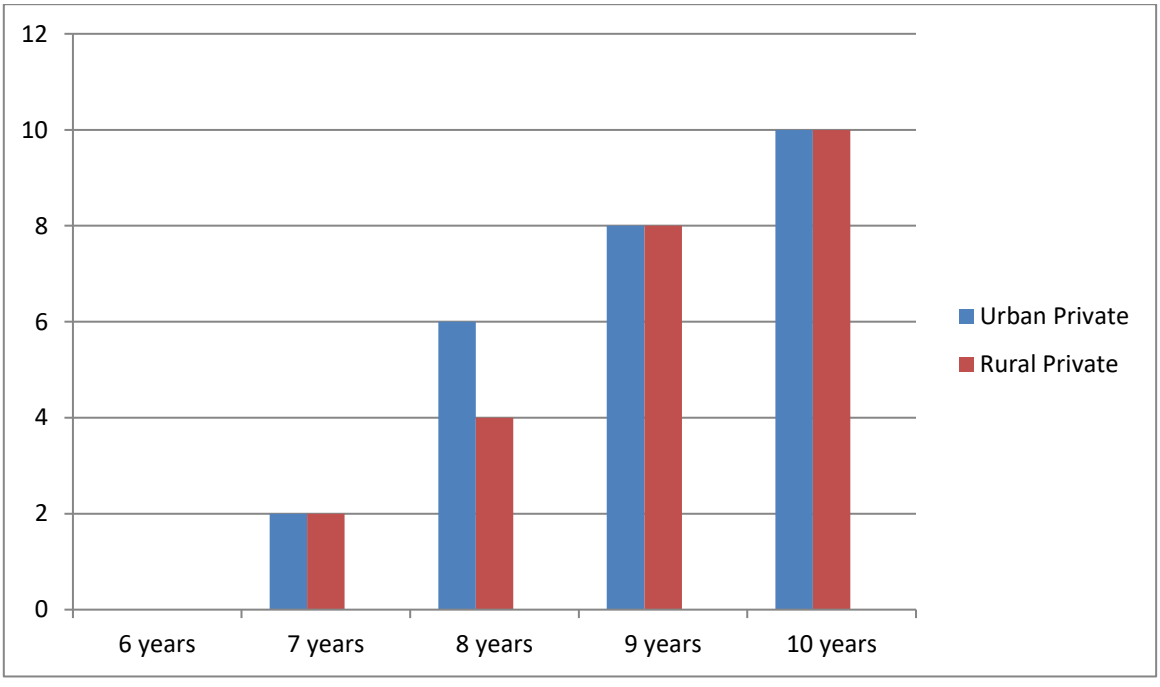

Figure 7: Comparison of Children's Liquid Conservation Ability of Urban Private and Rural Private Schools

Table 7: Comparison in the frequency of liquid conservers between Urban and Rural primary school children

Age Group	Urban	Rural

	N =100	Conservers	Percentage	N =100	Conservers	Percentage
6 Years	20	0	0	20	0	0
7 Years	20	5	25	20	3	15
8 Years	20	12	60	20	8	40
9 Years	20	16	80	20	14	70
10 Years	20	20	100	20	20	100

The above table shows that in urban areas the percentage values (0, 25) of 6 and 7 years were less than 50 percent which means that they are not liquid conservers, whereas the case of 8, 9 and 10 years old children is concerned as their percentage values (60, 80 and 100) were greater than 50, therefore it supports their case of liquid conserve. In case of rural school children the percentage values (0, 15 and 40) were less than 50 percent showing their case of non-liquid conservers; while 9 and 10 years old children have been proved as liquid conservers on the basis of their percentage values (70, 100) greater than 50 percent. From the above discussion it has been proved that in urban school, children become liquid conservers at the age of 8 years whereas in rural areas at the age of 9 years children become liquid conservers.

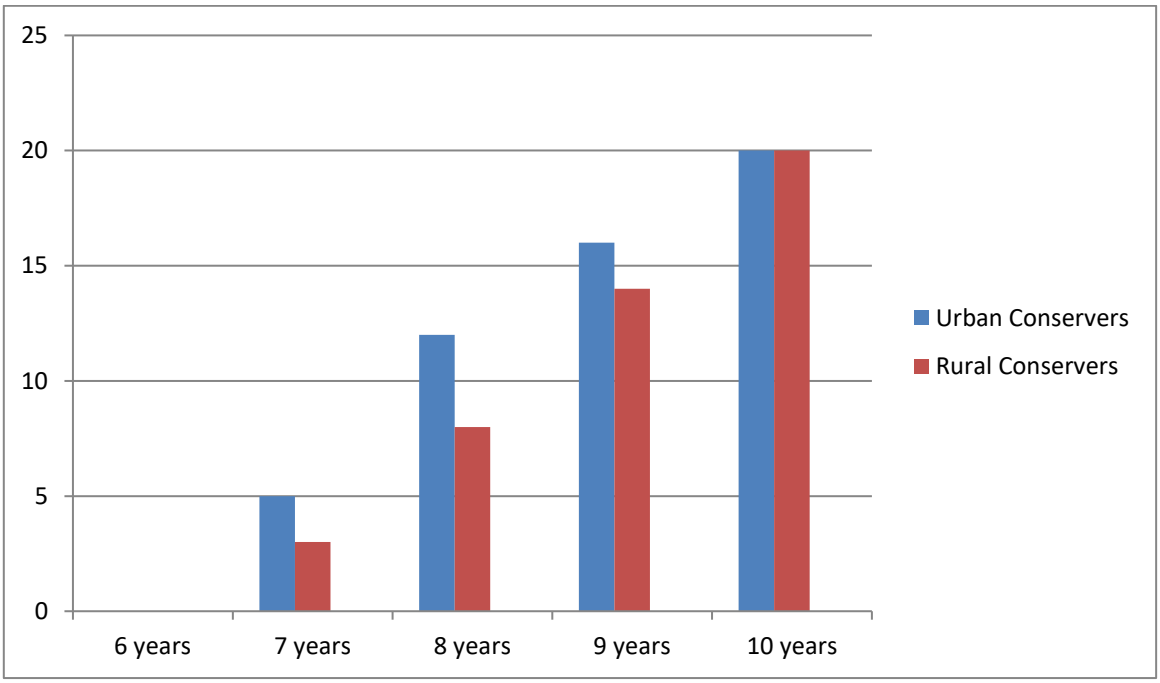

Figure 8: Comparison in the frequency of liquid conservers between Urban and Rural primary school children

Table 8: Comparison in the frequency of liquid conservers between Government and Private primary school children

Age Group	Govt. Schools			Private Schools		
	N =100	Conservers	%	N =100	Conservers	%

6 Years	20	0	0	20	0	0
7 Years	20	4	20	20	4	20
8 Years	20	10	50	20	10	50
9 Years	20	14	70	20	16	80
10 Years	20	20	100	20	20	100

The above table shows that in Government and Private schools both the percentage values (0, 20) of 6 and 7 years were less than 50 percent which means that they are not liquid conservers. Whereas in case of 8 years old children the percentage values (50) were just equal to 50. The percentage values (70, 100) of 9 and 10 years in Government schools were greater than 50, while in private school the percentage values (80, 100) were greater than 50 showing their cases of liquid conservers.

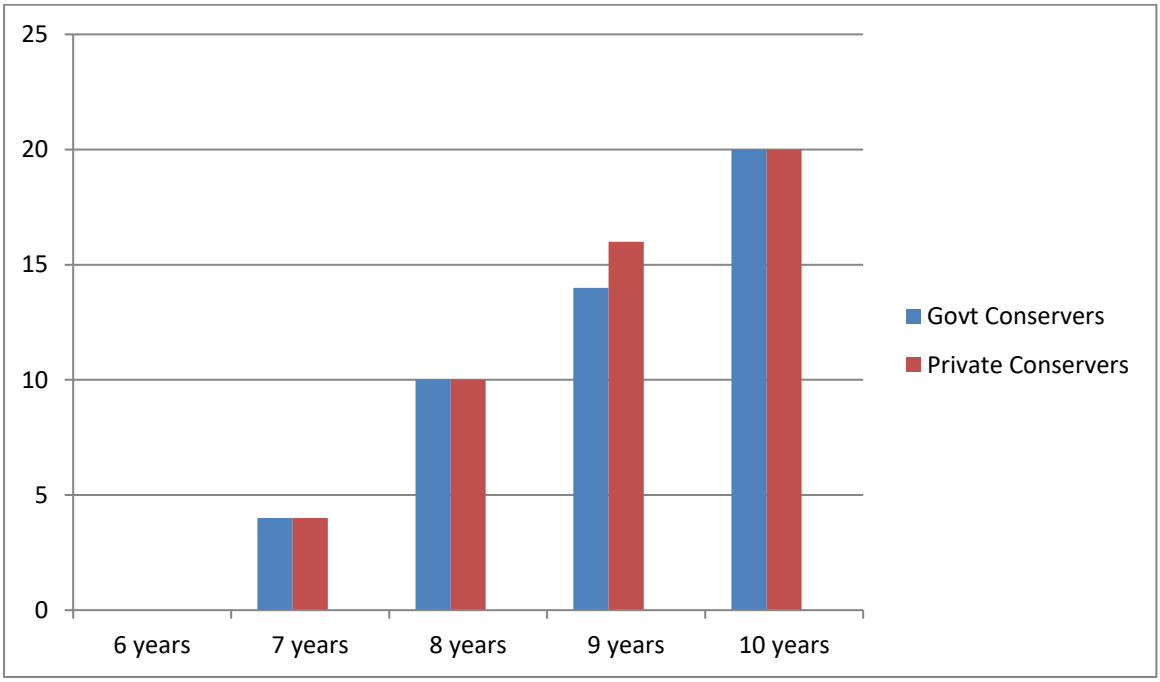

Figure 9: Comparison in the frequency of liquid conservers between Government and Private primary school children

5. Discussion

The study was purposed to investigate into the liquid conservation ability of girls at primary schools having age group of 6 to 10 years belonging to rural and urban areas each from government and private schools at district Nowshera. Numerous research studies at the national and international levels have been conducted on the conservation ability of children. Less research work has been conducted specifically on the liquid conservation ability of children. More specifically no research study pertaining to liquid conservation ability of children at primary level has been initiated in Pakistan and that of Khyber Pakhtunkhwa. Henceforth, this study paves the way for the upcoming researchers to conduct research specifically on the liquid conservation ability of children at primary level.No significant difference found to be there in the frequency of age group 6 to7 years old children of urban and rural areas of district Nowshera which shows that liquid conservation ability of that age group has no significant effect due to area, whereas in case of urban schools, children become liquid conserver at the age of 8 years as against the rural school where children become liquid conserver at the age of 9 years.No significant difference found in the frequency of 6-10 years old children of government and private schools. The

data revealed that urban government primary school children performed better than those of rural area.The results of this study found to be in conformity with the Theory of cognitive development of Jean Piaget. This study is also in line with the research conducted by [4] on *"Accelerated Cognitive Development—Piaget's Conservation Concept".*

5.1. Conclusion

Significant difference found to be there in the frequency of 6 to 10 years old girls' primary school liquid conservers. The results showed enhancement in the number of liquid conservers due to increase in age. There reported to be no significant difference in the frequency of 6 to 10 years old of urban and rural girls' primary school liquid conservers.No significant difference found to be there in the frequency of 6 to 10 years old of government and private girls' primary school liquid conservers.

5.2. Recommendations

Following are the recommendations of the study:

1. As the study was conducted in girls' schools only, it is recommended that boys' students may also be made part of the future study to validate the result.
2. Only eight girls' schools have participated in this study, so it is greatly felt and recommended that the number of schools may be increased to validate the result.
3. As the sample size of the study was 200, so it is suggested that the sample size may be increased by future researchers to validate the results.
4. As the study was conducted in District Nowshera only, therefore, it is recommended that the other regions may also be made part of the study. So that the future researchers may be able to make a region-wise comparison of liquid conservation ability of students.
5. As the study was conducted keeping into account only the liquid conservation ability of girl's students, so it is highly recommended that future research should be conducted on conservation of number, length, mass, area, weight and volume.
6. It is recommended for the future researchers to conduct the same research on students studying in madrassas in district Nowshera and other regions.
7. The research study may also be conducted on street children.
8. Research may be conducted on the comparative analysis of the liquid conservation ability of both boys and girls students enrolled in government and private schools and those of madrassas.
9. The research study may be conducted on the students having physical disability.
10. It is recommended that a comparative study may be conducted on physically able and physically disabled students.

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