

## **FACTORS AFFECTING SRI LANKAN CHILDREN'S CONCEPTION OF CONSERVATION AND SPACE**

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### **Abstract**

Conservation and Space are very important concepts for children's life. These concepts are helping the children learn mathematics and science subjects later. Jean Piaget also given more priority to these concepts in his study. The students' performance in mathematics and science are very low in Sri Lanka. Therefore, this study identified factors affected to Children conception of Conservation and Space. The researchers selected 87 children for this study as sample from three different sectors (urban, rural and estates). The ultimate sampling units of the study selected were 75 primary school children between the ages of 5-10 years. They represented the age ranges: 5-6, 6-7, 7-8, 8-9 and 9-10 years. The clinical methods used to identify their conception about Conservation and Space. Then, interview with parents and observation of children' home environment were used to identify the factors affect children's conception of conservation and space. From the data collected on child's home and school environment the following nine variables were tested against the total score children had obtained for conservation and spatial tasks. Kruskal-Wallis non-parametric Analysis of Variance test used to identify the factors. 'Child has siblings', 'Mother's education level' and 'Family type' (extended or nuclear) have an effect upon the development of conservation abilities in Sri Lankan children. 'Child has siblings' 'Mother's education level', 'Family type' (extended or nuclear) and 'Teachers' experience' have an effect upon the development of spatial abilities in Sri Lankan children.

*Key Words: Space, Conservation, Children, Performance, Students*

### **Introduction**

Many researchers highlighted that, number of factors influenced on children's conception of basic logical concepts like conservation and space. The pioneering developmental psychologist Jean Piaget (1952) eloquently described, Cognitive development consists of a progressive reorganization of mental processes as a result of biological maturation and environmental experience. These concepts are helping the children learn mathematics and science subjects later. Jean Piaget also given more priority to these concepts in his study. The students' performance in mathematics and science are very low in Sri Lanka. Therefore, this study identified factors affected to Children conception of Conservation and Space.

## **Child's Conception of Conservation and Space**

### ***Conservation***

Conservation is defined by Piaget as the recognition that a physical property remains untransformed despite evidence (Piaget 1962). Continuous quantity, volume weight, number and length are the physical properties. Price-Williams (1961), noted that, in the book titled '*The Child's Conception of Number*' Jean Piaget traced through the principles involved in the conception of number from early beginnings regarding the conservation of quantities, through the cardinal and ordinal correspondence, to additive and multiplicative compositions. The present study focuses on the following:

1. Conservation of quantities and invariance of wholes
2. The cardinal and ordinal correspondence

Piaget used the following technique for the experiment on Conservation of quantities and Invariance. The child is first given two cylindrical containers of the same size containing a quantity of liquid. The contents of one are then poured into two smaller containers of the same size and the child is asked whether the quantity of liquid poured from one big container into two smaller containers is still equal to that in the other big container.

After his experiments on Conservation of quantities and Invariance of the whole, Piaget noted that, the child begins and makes no further progress during the first stage (Sensory Motor Stage) and there is progress in the second stage (Pre-Operational Stage). The stage (Concrete Operational Stage) is characterized by the construction of extensive qualities through the equating of intensive differences. That is conservation in the first stage is absent in the child intermediary reactions on conservation in the second stage and necessary conservation at the third stage (Cook, 2005).

Piaget used sets of beads, for instance of liquid in the experiment of conservation of quantities and invariance of whole used for the experiment on Conservation of discontinuous quantities. After the experiment of Conservation of discontinuous quantities, Piaget noted that, during the sensory motor stage there is no conservation of the sets of beads, just as there was no conservation of liquid. The child not only thinks that the total quantity changes when a set of beads is poured from one container into another of different sets and during the concrete operation stage the child has the idea about conservation. Piaget published his findings as two books. Thereafter, many researchers replicated his experiments all over the world and reported their findings. Some of these findings on 'conservation' that agreed with Piaget's findings and some of them disagree with his findings.

In the early 1960s, Elikind (1961) conducted a study on ‘A systematic replication of Piaget’s investigations of ages’ with 175 children (25 from each age group ranging from 5-11 years). He found that 19% of the five-year children, 51% six year children, 70% of seven year children, 72% of eight years, 86% of nine year children, 94% of ten year children and 92% of eleven year children have shown the conception of quantity of weight and volume. He found that the results were in close agreement with Piaget’s findings of a regular age-related order of discoveries of the conservation of quantity, weight and volume.

Lovell and Ogilvie (1960) conducted a study with 322 children and noted that the three stages of development, as hypothesized by Piaget, were confirmed, but the evidence did not prove or disprove the assumption that the child arrives at the concept of conservation because he is able to argue logically in concrete situations. Uzgiris, (1964) conducted a study with Grade 1 to grade 6 children (each grade 20 children) and noted that in general the results supported Piaget’s theory. Conservation of quantity, weight and volume is attained in that order. There are situational differences and inconsistencies across materials which may be due to past individual experiences.

There are only a few studies conducted in conservation of number. According to Piaget (1952) children should be able to reason logically about quantity in order to understand number. However Nune and Bryant (2007) opine that children may know that two quantities are the same and still not make the inference that the number of objects in one is the same as the number of objects in the other. Winer (1974) explored whether children will have a higher ability to conserve number with small quantities rather than large quantities. Despite the evidence found of conservation, he found that young children cannot perform or be tested on ability to conserve. Agger (2007), replicated Winer’s study and noted that, children of ages 3 and 5 do not have the ability to conserve number in any manner.

### *Child’s Conception of space*

“The study of the concept of space, or rather, of the innumerable ideas involved in the concept of space, is for much reason an indispensable part of child psychology” (Piaget, 1956, p. vii)

Piaget’s research has shown that spatial skills develop progressively beginning from the sensory motor stage; where only egocentric and static representations are present (Rynhart, 2012). Piaget and Inhelder (1967) believed that children in the preoperational stage locate objects in the environment in relation to themselves and they understand limited

topological spatial relationships such as separation, proximity and open closed (Yilmaz, 2009). During the concrete operational stage children understand more complex topological relations using an external frame of reference such as order and enclosure and they begin to develop projective relations. In the formal operational stage they develop Euclidean spatial relations such as estimating straight- line relative distances and proportional reduction of scale (Yilmaz, 2009). In contrast to Piaget's theory there is an argument that spatial concepts begin with projective and Euclidean geometry. Topology appears only at the highest level (Thorp, 1995). There are many studies conducted to prove or disapprove which comes first.

According to Piaget there are six essentials in the child's development of space. These six essentials are as follows (Moore, 1976).

1. The representation of space is preceded by the representation of the object what is called object concept and object permanence.
2. The representation of space arises from the coordination and internalization of actions
3. The representation of space follows from the internalization of the prior sensorimotor group of spatial displacements.
4. The genesis of the image of the space arises from the internalization of deferred imitations of actions in space.
5. There are four general levels or structures of spatial knowing.
6. There are sequential classes of spatial relations which are constructed topologically.

According to Piaget, children's understanding of spatial concepts becomes apparent through their drawings. He believed that geometry is founded on the practice of drawing (Rynhart, 2012) and showed that children as early as three years of age were capable of making scribbles that could be differentiated as open or closed forms. For instance, a circle was represented as a closed curve. However since they are still incapable of distinguishing between straight and curved figures, their drawings of squares and triangles also resembled closed curves.

### **Research Problem**

Conservation and Space are important concepts. These concepts are the foundation for mathematics and science subjects too. But the pre-school teachers, primary school teachers and parents did not understand the importance of these concepts. The Sri Lankan students' performance in Mathematics is poor in the GCE OL (40%). Especially their performance in

geometry is very poor. Geometry is directly linked with Space concept. Similarly students' performance in Science also low compare to other subjects. The conservation idea is directly connect with the conservation concept.

### **Research Objectives**

#### ***Main objective***

To identify the factors affecting children's conceptions on Pre-mathematical concepts

#### ***Specific objectives***

To identify the Factors affecting Sri Lankan children's conception of Conservation

To identify the Factors affecting Sri Lankan children's conception of Space

### **Research Questions**

What are the factors affecting Sri Lankan children's conception of Conservation?

What are the factors affecting Sri Lankan children's conception of Space?

### **Literature review**

The literature review revealed that Piaget has suggested i) biological factors, ii) equilibration factors, iii) general social factors and iv) factors of educative and cultural transmission which includes social pressures and language patterns as factors that affect children's cognitive development ( Kothalawala 1980 , Carlson, 1973: 3). According to Kotelawala (1980 p97) the first factor is universal while the third factors mentioned above according to Piaget is common to all societies.

Literature also revealed that experiences related to cognitive tasks are found to be affecting the development of conservation and spatial abilities. Schooling, training, familiarity with cognitive operations (Mishra et al 2004) ) and opportunities provided by the environment support children's concept formation. This notion was supported by Piaget himself in a conversation with Biringuier (1977) as mentioned in the literature review (Section 2.5) A study conducted by Price-Williams in 1969, showed children of potters conserve quantity earlier than children of non-pottery making families due to experience (Brown and Desforges, 2006, p.81) ). On the other hand Piaget believed that children learn best by experimenting for themselves (Flemming, 2004). This supports the fact that children who have opportunities to experiment tend to learn thorough experiences. According to

Mohler (2008) mathematical background, achievement, and problem solving ability; as well as musical background are potential roots for the development of spatial ability.

### **Research Methodology**

The present study was designed to find out Factors affecting Sri Lankan children's conception of Conservation and Space. Therefore, both quantitative and qualitative approach were applied in collecting data. Qualitative approach (Case study design) was applied to identify factors affecting children's conception of conservation and space and interventions required in the development of these concepts.

### **Population**

The population of the present study is all Sri Lankan primary school (5- 10 years) children. However, for practical considerations the accessible population of the study was limited to Kalutara District in the Western province. Therefore, Primary schools (5- 10years) children in the Kalutara District were the population of this study. Kalutara District consists of three Education Zones and all three social sectors namely urban, rural and estate. The researcher found that this district was the most relevant district in the Western Province in achieving all the objectives of the study.

The list of registered pre-schools in the Kalutara District was obtained from the Competent Authority in pre-school education of the Western Province Provincial Council. There were 752 pre-schools in all three Zones of Kalutara District. Out of these pre-schools 717 use the Sinhala medium while 35 use the Tamil medium. The number of schools with primary classes in the Kalutara District was collected from the Census and Statistics Unit of the Census and Statics Department of the Ministry of Education. There are 87 schools with primary grades in Kalutara district. Out of these, 67 schools use the Sinhala medium while 20 use the Tamil medium. The population of pre-schools and schools with primary grades are given in the following Table 1.

**Table 1.**

**Number of Primary Schools with Primary Classes in the Kalutara District**

Zone	Division	No of Schools		Total No of Schools
		Sinhala	Tamil	
Kalutara	Panadura	4	0	4
	Dodangoda	3	2	5
	Kalutara	1	0	1
	Beruwala	8	0	8
Horana	Bandaragama	5	0	5
	Horana	13	2	15
	Bulathsinhala	6	4	10
Matugama	Matugama	6	7	13
	Agalawatta I	6	4	10
	Agalawatta II	7	0	7
	Walallawita	8	1	9
<b>Total</b>		<b>67</b>	<b>20</b>	<b>87</b>

Source: Statistical Hand Book- 2022, Department of Census and Statistics-Sri Lanka

***Samples of the study***

The ultimate sampling units of the study selected to achieve first two objectives were 75 primary school children between the ages of 5-10 years. They represented the age ranges: 5-6, 6-7, 7-8, 8-9 and 9-10 years.

***Sampling Techniques***

A mixed method was used in selecting the samples of this study. Purposive sampling method was used in selecting the primary sampling unit (Administrative District) while stratified random sampling method was used in drawing ultimate sampling units. When subpopulations within an overall population vary, it is always advantageous to sample each subpopulation (stratum) independently.

***How the sample was selected***

The first stratum of the study population was twenty-five Districts in Sri Lanka. In view of the appropriateness to the problem investigated and other reasons such as costs involved in

conducting a study of this nature, the researcher selected Kalutara district. It consists of Kalutara, Horana and Matugama Education Zones where all ethnic groups (Sinhala, Tamils and Moor/Malay) and all social sectors (Urban, rural, Estate) live. This district was selected purposively.

The second stratum was the eleven Education Divisions functioning under the above mentioned three Education Zones (these Education Divisions are depicted in the Table 3.1). From these, the researcher selected one Education Division from each of the Education Zones. From these Education Divisions two Divisions (Kaluthara and Horana) were selected randomly while one Division (Mathugama) was selected purposively to include the estate sector.

The third stratum was the primary schools/schools with primary classes. One primary school/school with primary classes was selected from each of these Education Divisions using the Random Sampling Method. Estate schools were selected from among estate schools randomly. The sample included both media of instruction (Sinhala and Tamil) and the main social sectors (Urban, Rural and Estate).

The Fourth stratum was the children aged 5-10 years in the sample of primary schools/ schools with primary classes. This is the ultimate sampling unit of the study and was drawn using random sampling method to cover both media of instructions and the three social sectors urban rural and estate. Details of each sample are indicated in the following Tables 3.3 and 3.4.

**Table 2**

**Details of Primary School Children Sample by Education Division, Sector and Medium of Instruction**

Age	Selected Education Division	Selected No of Schools	Selected No. of Children Sector and Medium-wise			Total
			Urban (Sinhala)	Rural (Sinhala)	Estate (Tamil)	
5-6 years	Kalutara	01	05	-	-	05
	Horana	01	-	05	-	05
	Matugama	01	-	-	05	05
6-7 years	Kalutara	01	05	-	-	05
	Horana	01	-	05	-	05
	Matugama	01	-	-	05	05
7-8 years	Kalutara	01	05	-	-	05
	Horana	01	-	05	-	05

	Matugama	01	-	-	05	05
8-9 years	Kalutara	01	05			05
	Horana	01		05		05
	Matugama	01			05	05
9-10 years	Kalutara	01	05			05
	Horana	01		05		05
	Matugama	01			05	05
<b>Total</b>		15	25	25	25	75

Source: Sample survey 2022

All the 75 students' parents were interviewed by the researcher. A comprehensive questionnaire was given to the 15 teachers.

### **Main Findings of the present study**

The researcher gathered data on the child's home and school environment to identify environmental factors that reflect on children's performance in conservation and spatial tasks. According to Geist (2010), young children may not be able to add or subtract, but the relationships they are forming and their interactions with a stimulating environment encourage them to construct a foundation and framework for what will eventually become mathematical concepts. For children to act on objects they need the support of the home and school environments. Therefore, this study is focused on home backgrounds and the classroom environments to identify supportive and hindering factors in relation to conception of Conservation and Space. Kruskal-Wallis non-parametric Analysis of Variance (One-way ANOVA on ranks) was conducted using PASW Statistics 18 (formerly SPSS Statistics) to find factors affecting children's conception of 'conservation' and 'Space'.

### ***Results of the Kruskal-Wallis non-parametric Analysis of Variance (One-Way ANOVA)***

From the data collected on child's home and school environment the following nine variables were tested against the total score children obtained for conservation and spatial tasks.

1. Gender of the child: (Male/ Female )
2. The household sector the child lives in( Urban, Rural, Estate)
3. Family income ( Below 10000/-; Rs.10,000/-; to Rs20,000/-; Rs.20,001/- to Rs.30,000/-, Rs30,001/- to Rs.40,000/-, Rs.40,001/- to Rs.50,000/-, Rs.50,001t/- to Rs.60,000/-, Rs.60,001/- to Rs.70,000, Rs.70,001/- to Rs.80,000/-, Rs.80,001/- to Rs.90,000/-, over Rs.90,000/-)

4. Child has siblings: (Only child, has siblings )
5. Mother's education: (Primary, Secondary below (GCE OL), passed GCE(OL), passed GCE(AL), Graduate)
6. Family type: (Extended family, Nuclear family)
7. Teacher's professional qualifications (Trained/Bed/ Dip in NCOE, Untrained)
8. Teacher's educational qualifications: (GCE(OL), GCE(AL), Diploma National Colleges of Education, Graduate )
9. Teacher's experience(0-4 years, 5-8 Years, 9-12 Years, more than 12 years)

Father's education was not selected since most research specify mother's influence in predicting cognitive development of young children (Hernandez, 2014 Schady, 2011, Melhuish, 2010,) and some research consider parent's education as mother's education (Hernandez, 2014).

From the Outputs of the PASW statistics 18 to the Kruskal-Wallis non-parametric Analysis of Variance (One-way ANOVA on ranks), p-values 2 values degree of freedom of these tests are presented in the following Table 4.24.

**P values and the  $\chi^2$  of the Kruskal-Wallis test**

	Variables	Degree of freedom	Conservation		Space	
			p-value	$\chi^2$	p-value	$\chi^2$
1.	Sector	2	0.120	4.242	0.643	0.885
2.	Gender	1	0.474	0.513	0.924	0.009
3.	Family monthly income	9	0.344	8.975	0.201	11.013
4.	Child has siblings	1	<b>0.001</b>	3.939	<b>0.002</b>	3.454
5.	Mother's education level	3	<b>0.003</b>	5.381	<b>0.001</b>	3.494
6.	Family type	1	<b>0.002</b>	0.877	<b>0.003</b>	0.953
7.	Teacher's professional qualifications	1	0.158	0.691	0.336	0.925
8.	Teacher's Educational qualifications	3	0.247	4.140	0.978	0.196
9.	Teacher's experience	3	0.134	5.586	<b>0.003</b>	0.665

Source: PASW output

The confidence level was 5% ( $\alpha=0.05$ ) for this study. According to the table all the p values for conservation concept are greater than 0.05 ( $p>\alpha$ ). Therefore, there is no evidence to indicate that the nine variables tested has an effect upon performance in conservation tasks.

The p-values for child has siblings (0.001), Mother's education level ( $p=0.003$ ) and Family type ( $p=0.002$ ) are less than  $\alpha$  and p-value for the other variables are greater than for the conservation concept. This implies that, 'child has siblings' 'Mother's education level' and 'Family type' (extended or nuclear) have an effect upon the development of conservation abilities in Sri Lankan children.

The p-values for 'child has siblings' ( $p=0.002$ ), Mother's education level ( $p=0.001$ ), family type ( $p=0.002$ ) and teacher's experience ( $p=0.003$ ) are less than  $\alpha$  and p-value for the other variables are greater than for the space concept. This implies that, 'child has siblings' 'Mother's education level', 'Family type' (extended or nuclear) and 'Teachers experience' have an effect upon the development of spatial abilities in Sri Lankan children.

### **Conclusions and Recommendations**

1. Variation in Sri Lankan children's conception of conservation and space according to the sectors they live in
2. Factors affecting Sri Lankan children's conception of conservation and space
3. Intervention needs of Sri Lankan children in relation to the development of conservation and spatial abilities.

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