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LEARNING OF MATHEMATICAL CONCEPTS IN RELATION TO SPATIAL ABILITY AMONG SECONDARY SCHOOL PUPILS

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ABSTRACT

Mathematics is a subject of problems. Its teaching and learning demands solving of innumerable problems. Efficiency and ability in solving problems guarantee the success in learning of the mathematical concepts. Learning mathematics is basically a constructive process, which means that pupils gather, discover, create mathematical knowledge and skills mainly in the course of some social activity that has purpose consequently mathematics classroom instruction should move away from the information transmission model meaningful and authentic context should play a crucial role in mathematics learning and teaching, therefore, we need on integrated approach to mathematics teaching. Mathematics helps to promote logical thinking, develops truthfulness in thinking, exactness and clarity of thought and promotes power of concentration. It develops the attitude of discovery in pupils'.

Spatial ability is category of reasoning skills that refers to the capacity to think about objects in three dimensions and to draw conclusions about those objects form limited information, for Example, a person with good spatial reasoning skills might be particularly quick to finish a tangram puzzle, a game in which smaller shapes must combine to form a larger shape. Someone with good spatial abilities might also be good at thinking about how an object will look when rotated. These Skills are valuable in many real world situations and can be improved with practice. Many tests of spatial ability have been developed, as well as mental exercises meant to improve these reasoning skills. Therefore secondary school children's learning of mathematical concepts in relation to spatial ability is found very significant for the present study.

Key words: Learning mathematical concepts, Spatial ability, Secondary school pupils.

Introduction:

Our society is moving in to a technological era. We need people with sound mathematical skills. The mathematical curriculum has undergone periodic changes. In the sixties, there was the way of modern mathematics throughout the world including our country. Whether the programme of modern mathematics is successful or not, is not relevant. But qualitatively better mathematics education is undoubtedly the need of the study. Spatial ability can be defined as the ability to interpret and make drawings, form mental images, and visualize movement or change in those images. Most of the spatial ability tests contain two, three or multi dimension shapes, one is required to reason with the given dimensions to reach to the right conclusions. Spatial ability tests offer different sizes of shapes. One may identify forms

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from the patterns or vice versa, depending upon the sizes. The shapes may change their patterns with the change of sizes. Some problem may contain different plans with different shapes. The diagrams are rotated in the plans to see how much sharp the once memory is. One may be offered 2-D or 3-D shapes to know their direction of rotation in the plans. One may be required to visualize disintegration of a shape in parts and reassemble them at another place.

Review of related literature

In the present study the investigator has reviewed the researches done in the field of learning of mathematical concepts in relation to spatial ability among secondary school pupils. SUMANGALA (1995) studied the relationship between mathematical aptitude and achievement in mathematics found all the components of mathematical aptitude, i.e numerical ability, numerical reasoning, ability to use symbols, spatial ability and abstract reasoning abilities are significantly correlated to achievement in mathematics.

GIRIJA DEVI THAMPURATTY, N.R. (1996) studied socio-economic status of creative high achievers and creative low achievers in mathematics. 1. There is significant difference in the mean scores of parental income of creative high achievers and creative low achievers.2. There is significant difference in the mean scores of parental occupation level of creative high achievers and creative low achievers. 3. There is significant difference in the mean scores of parental education level of creative high achievers and creative low achievers .MAHENDER REDDY.SARSANI and RAVI MADDINI (2010) : studied achievement in mathematics of secondary school students in selected variables, the findings were as follows. Girls performed better than boys in mathematics scholastic achievement test. Type of school as influence on the performance on mathematics scholastic achievement test.There is influence of locality on the performance in mathematics scholastic achievement test. Based on the above reviews the investigator also intended to study the learning mathematical concepts in relation to spatial ability among secondary school pupils.

Need and importance of the study:

The learning abilities of mathematical concepts of students may differ. Bruner, Good Now and Austin differentiate between three types of concepts namely conjunctive, disjunctive and relational basing on the mode of combining attributes. In the conjunctive concept the appropriate values of several attributes are jointly present. In a disjunctive category the appropriate values of one attribute or of both are present. A relational concept is one that has a specific relationship between attributes. In these three concepts conjunctive concepts are considered easy for learning and teaching. The selected concepts were mensuration from arithmetic, sets from algebra and symmetry from geometry. Mensuration deals with the measurement of the length of sides, areas and volumes related to the geometric figures. The set concept and set language play an important role in mathematics in unifying different branches of mathematics. Symmetry has a pleasing effect due to the uniformity in the shape of anything. People make use of it in art, design and decoration. Howard Gardner has identified the following as Visual spatial intelligence.1) The ability to think in pictures 2)The ability to visualize a future result by imagining things in the eyes of the mind to have a sense of direction . Such pupils can assemble the parts quite easily, can follow diagrams and make up their own

points when some sketches are provided to them. They can visualize how things look from different perceptive and how a building might look from a plan. Spatial ability test is one among the differential aptitude test batteries. All these problems are framed with geometrical shapes. This is meant for testing the ability in spatial visualizations by presenting two-dimensional geometric figures (Variously shaded). There are imaginatively manipulated, each to frame three-dimensional figures. The purpose is to test ability to visualize constructed figures, variously rotated. The pupils have to analyze the picture and identify the alternative correct pictures in three dimensional shapes. Therefore Secondary School Pupil's differ in their levels of learning of mathematical concepts in relation to Spatial ability is significant for the present study.

Title of the study:

"Learning of mathematical concepts in relation to spatial ability among secondary school pupils."

Objectives of the Study:

1) To find out the level of learning of mathematical concepts of secondary school pupils and classify them.
2) To find out the level of Spatial ability among Secondary School Pupils and classify them.
3) To find out the relation between the learning of mathematical concepts and spatial ability of secondary school pupils.
4) To find out the influence of the learning of mathematical concepts among secondary school pupils differ with respect to following variables.

- Gender (Boys/ Girls)
- Location (Urban/ Rural)
- Status of the school (Govt / Private)

Hypotheses of the study:

1) There would be no significant difference between boys and girls in their learning mathematical concepts in relation to Spatial ability
2) There would be no significant difference between rural and urban Secondary School Pupils in their learning mathematical concepts in relation to Spatial ability.
3) There would be no significant difference between Government and Private Secondary School Pupils in their learning mathematical concepts in relation to spatial ability.

Method Used: The present study falls under normative survey method.

Sample of the study:

For the present study the investigator has taken up a stratified random sample of 31 schools in 15 Govt (aided ,Z.P, Muncipal)and 16 Private schools in 620 pupils around Krishna district.

Tool of the study:

A test was constructed on mathematical concepts in practical situations on three areas containing 60 items from VIII class mathematics text book by the investigator. A standardized tool on Spatial ability, a differential aptitude test containing 40 questions was used.

Reliability and validity of the questionnaire:

In the present questionnaire, a systematic effort was made by the investigator to examine the test items related to the objectives of the study. While preparing the test, the investigator consulted around 10 experts in the field of mathematics. The difficulty level and discriminating power of each test item was calculated. Scale followed to identify the items in terms of validity (Refer: measuring educational achievement, Robert.L. Ebel pg no. 364). Items which were negative and which had below 0.2 discriminating power were cancelled. Thus 12 items were rejected. Then again with the remaining 48 items the final test was conducted. Space relations are one of the differential aptitude tests. The reliabilities of the parts or the power tests are about 0.90. All DAT tests are essentially power tests whose reliability coefficients are high. Concurrent validity was found Anne Anastas; Psychological testing (1976) IV edition, Macmillan Publishers, New York.

Data analasis:

Objective 1 To find out the level of mathematical concepts of the secondary school pupils and to classify them.

Table 1 ***The Mean, % of Mean, S.D and 1/5th of Mean of the total sample in learning of mathematical concepts.***

N	***Mean***	***% of Mean***	***Standard deviation***	***1/5th of Mean***
620	21.5145	44.82	7.2270	4.3029

Interpretation:

High school pupils are found to have average level of learning of mathematical concepts since 1/5th of mean value is less than the S.D value. The sample of pupils is heterogeneous in learning of mathematical concepts. The sample is shows variation in its learning of mathematical concepts.

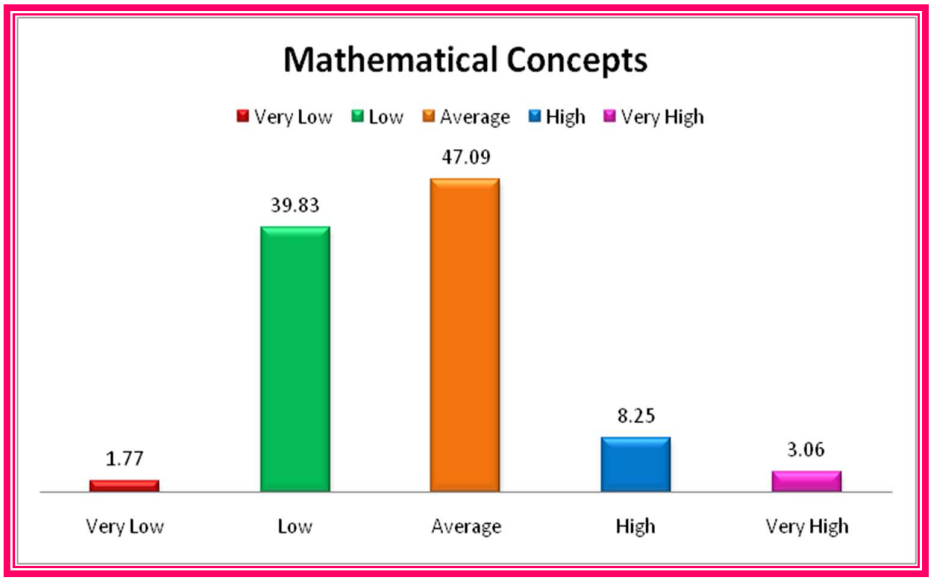
Table 2 ***Classification of pupils on the basis of their level of learning of mathematical concepts***

Category	***Scale***	***No. of students***	***Percentage***
Very Low	0-9	11	1.77
Low	10-19	247	39.83
Average	20-29	292	47.09
High	30-39	51	8.25
Very High	40-48	19	3.06

Interpretation:

Most of the pupils, nearly half of them have average level of learning of mathematical concepts. Nearly two fifths of them have low level of learning and eighty seven percent of the pupils have only low and average learning of mathematical concepts.

Classification of pupils on the basis of their learning mathematical concepts.



Interpretation:

'Mathematics is the queen of all sciences'. The common belief and observation is that if the child is good in mathematics, he or she can easily learn any subject involving logical thinking, analytical thinking and synthetic thinking abilities. In the present study pupils are found to have average level of learning of mathematical Nearly two fifths of them have low level of learning and eighty seven percent of the pupils have only low and average learning of mathematical concepts.

Objective : 2 To find out the spatial ability among secondary school pupils and classify them.

Table 3. ***The mean, % of mean, 1/5th mean and S.D value of the total sample in spatial ability test***

N	*Mean*	*% of mean*	*S.D*	*1/5th of Mean*
620	56.43	57	14.33	11.28

Interpretation:

The secondary school pupils are found to be average spatial ability. The pupils are found to be heterogeneous in their spatial ability since the 1/5th of Mean value is less than the S.D value.

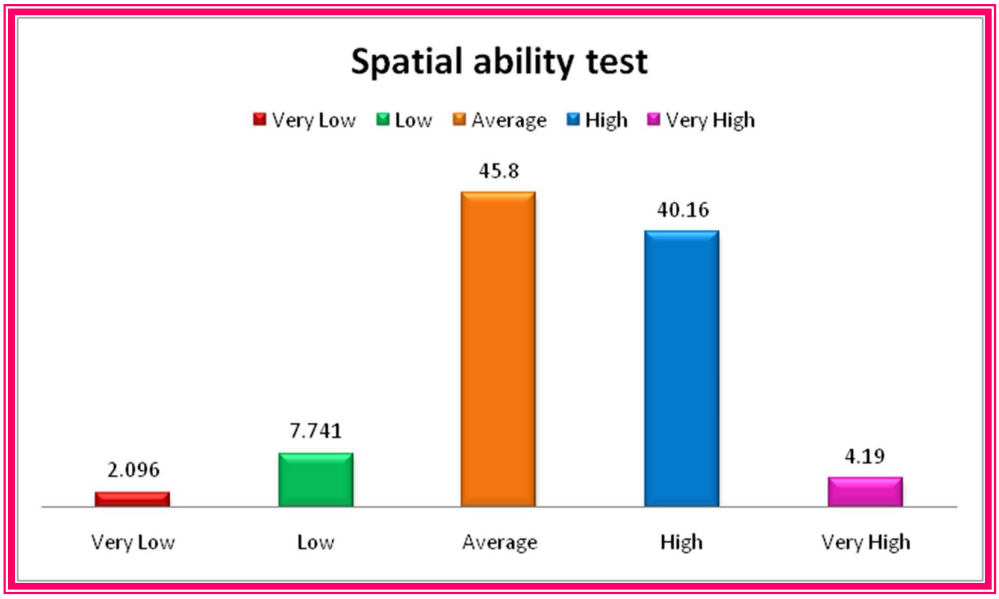
Classification of pupils

The maximum possible score is 99 and the minimum possible score is 0 hence the range 100 is divided into five categories having provision for 20scores in each of the categories, denoted as very high, high, average, low and very low.

Table 4: ***Classification of pupils on the basis of their level of spatial ability test.***

Category	*Scale*	*No. of students*	*Percentage*
Very low	0-19	13	2.096
Low	20-39	48	7.741
Average	40-59	284	45.80
High	60-79	249	40.16
Very High	80-99	26	4.19

Classification of pupils on the basis of their spatial ability test.



Interpretation: The ability to visualize constructed figures on seeing the two dimensional geometric figures by imaginative manipulation is found just above average for the present sample. Their ability to find space relations is appreciable. Most of the pupils have average level of spatial ability. Two fifths of the sample ofpupils are found having good spatial ability.

Objective 3

To find out the relation between learning of mathematical concepts and spatial ability of secondary school pupils.

Table 5: Relation between learning of mathematical concepts and spatial ability

S.NO	*Variable*	*N*	*df*	*r- value*
1	Mathematical concepts	620	620-2= 618	0.1222^{**}
2	Spatial ability test	620		

Interpretation:
'r' value is found significant at both the levels, it can be inferred that there is significant positive relation between learning of mathematical concepts and spatial ability of secondary school pupils.

Objective 4: To find out the influence of the learning of mathematical concepts among secondary school pupils differ with respect to Gender, Location, Status of the school.

Table 6: Table showing the variable wise distribution mean, S.D, t-value for learning mathematical concepts.

S. No	Variable	Type	N	Mean	S.D	t-value
1	Gender	Boys	270	21.786	8.676	0.7857 NS
		Girls	350	21.303	5.864	
2	locality	Urban	280	20.768	5.725	2.100*
		Rural	340	21.756	5.956	
3	Status of the school	Govt	342	57.9	12.8	2.83**
		Private	278	54.6	15.9	

Interpretation:

Learning mathematical concepts have not significantly varied with Gender. It was found that locality, status of the school influences the secondary school pupils.

Discussion:

Learning mathematics is basically a constructive process that extends beyond learning concepts, procedures and their applications. Mathematics is more than vast collection of fixed concepts and skills. Butler and Wren (1960) maintain that through the teaching of mathematics students attain higher intellectual and mathematical abilities like logical thinking, rational reasoning, attending to the essential aspects of the sum, orderly presentation, precision, accuracy, analytical and inductive skills. Spatial ability tests measure the ability to manipulate shapes in two dimensions or to visualize three dimensional objects that have been rotated or which are viewed from different angles or objects that have different markings on their Surfaces.

Conclusion:

The Secondary school pupils are found having average spatial ability and only average level of learning of mathematical concepts. Positive relation between learning of mathematical concepts and spatial ability of secondary school pupils. Another appreciable finding is that girls are on par with boys in learning of mathematical concepts. Govt schools had significantly better

their learning spatial ability than the private secondary school pupils.And the most important rare finding is that rural pupils have better learning of mathematical concepts than that of urban pupils. Therefore efforts are to be made caring these directions to improve the teaching and learning of mathematical concepts in secondary schools by focusing more on concepts in mathematics rather than mere formulae and exercise and re-orienting the teachers and parents towards these aspects.

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