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"The Effect of Gender, Medium of instruction, Parent's Educational and Socio-Economic background on Children's Conceptions and Abilities in Graphical Representation and Interpretation of Geometrical Concepts."

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For many students mathematics is the major area of difficulty. Mathematics learning is a complex enterprise. It is very difficult to understand why children fail in mathematics. The reasons behind success and failure in learning mathematics are a function of number of cognitive and non-cognitive factors. What is important to note here is that severe difficulty in learning mathematics can be a debilitating problem in school and in later life? For example, not all students with learning difficulties have difficulty with learning same concepts. Infact, some students with severe reading disability have strong mathematics skills. Yet, mathematical learning disorders do affect a significant portion of the learning – disabled population. Students come across different graphs in their day-to-day life. To understand these graphs, they should have the knowledge of different concepts involved in it. Using this knowledge children learn to represent and interpret the data through graphs. Graphical representation and interpretation of geometrical concepts is a complex cognitive activity. By these graphs we not only represent and interpret concrete things but also abstract relations between different entities. The cultural context, institutional affiliation, the network of social practices, parental educational background, socio-economic background and a number of other factors influence children's abilities of conceptualization and interpretation and in general formation of ideas. The way children formulate concepts about geometrical graphs and their abilities of interpretation about various mathematical notions cannot be understood without considering the various dimensions of their location and existence.

Hence it is felt necessary to study the conceptions and abilities of children in graphical representation and interpretation of geometrical concepts. The most important significant dimension of this work is to understand the bearing of this work on the enterprise of cognitive science research in mathematics. A cursory look at the existing research on children's learning reveal the disappointing and also challenging aspects. Apart from the general lack of a scholarly educational tradition, the inadequacies of such study come about because of the fear of approaching such a complex area as children's inner lives. Instead of answering curiosity with observation, much educational research has attempted to reduce the problem into the simplistic solutions, by isolating a particular hypothesis and trying to prove it, or by trying to focus on what is easy and empirical. This discussion makes us realize the importance of research in mathematics education. In the present study the sample consisting

of 240 respondents chosen from 24 different types of schools in India were asked to solve a set of questions related to the conceptions and abilities in graphical representation and interpretation of geometrical concepts. The tool that was constructed for this purpose consisted six items related to geometrical concepts. The conceptions and abilities of representation and interpretation was analyzed with respect to the independent variables -- type of school, gender, medium of instruction, parents educational background, social background and parents income per month. The answers given by the children were evaluated with respect to the level of precision. The data collected is then analyzed using descriptive and inferential statistical techniques.

Keyword: Geometrical, Statistical, Graphs, Verbal, Symbolic, Representation, Interpretation

INTRODUCTION

How do children represent their ideas about different variables? How do children interpret geometrical ideas? What aspects do they consider while constructing their conceptual frameworks? In general, how one can understand the complex ramifications of children's mathematical learning styles? These are some of the seminal questions in the field of contemporary mathematics education and pedagogy. This article purports to grapple some of the above questions. In the process of addressing these questions, this work attempts to discover certain subtle regularities and map complex intricacies with respect to children's learning mathematical knowledge. Understanding how children learn mathematics is a highly complex cognitive enterprise. However, it is impossible to construct a meaningful account of children's learning mathematics without considering certain important non-cognitive factors. The mutual influences of cognitive and non-cognitive factors make the learning events complex and problematic. In what follows an attempt is made to map the boundaries of children's mathematical learning processes. The purpose of this attempt is to make a way to meaningfully interpret children's representations of mathematical ideas with special reference to geometrical graphs. Many children have difficulty in learning mathematics, and children experiencing mathematics problems can be found at all age levels (NAEP 1983, Aiken LR 1971). During pre-school and primary grades many children have trouble matching or sorting objects, differentiating various sizes, and understanding the language of mathematics (Schoen HL, Friesen CD, Jarrett JA, Urbatsch TD 1981). For some children, difficulties with numerical relationships begin at an early stage (Piaget J, 1970). The ability to count, match, sort, compare and understand one-to-one correspondences hinges on the child's experiences in manipulating the objects. Students with a short attention span, disturbed perceptual skills, or inadequate motor development may not have had sufficient or appropriate experiences with activities of manipulation that would prepare for understanding of space, form, order, time, distance and quantity (OEEC 1961, Marty RH 1988). During the elementary grades the child with math difficulties most likely encounters problems with computational skills. Problems with measurement, fractions, percentages and decimals can also be experienced during the elementary grades (Mathew JH 1988). Math difficulties among secondary level children are not necessarily different from those of younger children. According to Wallace and McLaughlin (1979) many students have problems in mathematics at secondary level because of inadequate foundational skills. Because learning problems in mathematics are often connected to other academic difficulties, it is frequently necessary to investigate related deficits. Difficulties in discrimination, memory, comprehension and handwriting can effect achievement in mathematics as well as in other academic areas.

Children's performance in mathematics primarily depends on their pre-requisite skills. Children may be introduced to a mathematics skill before they are ready for such instruction. Attempts at teaching only confuse them. These children need more experiences with pre-number concepts and skills. Children with poor number sense have been observed to have an inaccurate or imprecise body image. They may be unable to understand the basic relationship of the body parts. When asked to draw a picture of a human figure, they may draw the body parts as completely unrelated or misplaced. In the existing mathematics teaching practices, the main emphasis is on communication of facts cum principles, laws, and theories by the teacher for doing a certain kind of task. Further, teachers organize their activities in a systematic sequential way i.e., in a methodical way and make children to practice the same method and do the tasks of the same kind (National Council of Supervisors of Mathematics 1989). In these kind of teaching learning practices children are treated as objects, which can store information and also to certain extent memorize it. No creative learning situations are provided to children in such kind of technologies of instruction. Hence, such conventional mathematical procedural learning methods are totally unfavorable for learners to construct their own ideas and schemes. Graphical representation and interpretation of geometrical concepts is a complex cognitive activity. By these graphs we not only represent and interpret concrete things but also abstract relations between different entities are represented through them. Unlike statistical graphs geometrical graphs are mostly abstract and difficult to understand the relationship that exists between the variables involved in it. Interpreting these graphs is possible if one has a good knowledge about the various concepts involved in it. Objectivity and precision in one's approach enable an individual to interpret the graph correctly. Exposure to mathematics education and creative learning allow children to strengthen and develop these abilities (Freudenthal H 1970). The abilities of representing and interpreting geometrical graphs help children in understanding the problems we face and in predicting future phenomena. Hence it is felt necessary to study the conceptions and abilities of children in graphical representation and interpretation of geometrical concepts. In the present study the respondents were asked to solve a set of questions related to the conceptions and abilities in graphical representation and interpretation of geometrical concepts. The tool that was constructed for this purpose consisted six items related to geometrical concepts. The six items consists of representation and interpretation of data from verbal to symbolic, verbal to graphical, symbolic to verbal, symbolic to graphical, graphical to verbal and graphical to symbolic from. Each item consists of six questions. So there are 36 questions related to geometrical concepts. The conceptions and abilities of representation and interpretation was analyzed with respect to the independent variables -- type of school, gender, medium of instruction, parents educational background, social background and parents income per month. The answers given by the children were evaluated with respect to the level of precision. In other words, the responses were classified into High Precision, Medium Precision, Low Precision, Irrelevant responses. On the basis of the quantum of precision of the responses scores were given. For example, a student who explains and interprets an item correctly, that is with high precision was given 3 marks, a student with medium precision was awarded 2 marks, a student with a low precision of response was awarded 1 mark. Students with irrelevant answers were awarded zero mark.

Significance of the Study

A significant amount of school time is spent trying to teach children mathematics. Nevertheless, learning and achievement problems in mathematical areas are act of life for many students (Bandura A 1986). This may be due to the highly abstract and symbolic nature of mathematics and the fact that many children solve mathematics problems by rote without fully understanding the underlying process. Teachers must understand the mathematics learning processes before attempting to assess and remediate mathematics difficulties. Students must possess a set of pre-requisite readiness skills in mathematics before formal mathematics instruction is undertaken (Barnett V 1982, Cummins KA 1977, Davies C 1965). If children do not possess certain skills like classification, comparison, counting, reversibility and compensation, serration and conservation, formal mathematics instruction should probably be delayed. Students who lack these skills when they leave school are likely to encounter problems of success and survival in their adult lives. Despite general agreement among educators about the importance of mathematics to life successes, a significant portion of students possesses serious mathematical learning deficiencies. One can teach mathematics effectively if one explores and recognizes different teaching styles, which are appropriate for different types of mathematical work (Husen T 1967, Cummins KA 1977). For example, a whole-class teaching approach can be adopted for the purpose of introducing mathematical ideas, expositions and reviewing work at the end of lessons. Through group work one can manage practical work and also to certain extent theoretical exercises. For children with learning difficulties and gifted individual work / teaching may be useful. In this context Suzanme Edwards, mentions a few words about a curriculum policy, which include a statement on teaching styles. "Teachers use a variety of teaching styles including opportunities for pupils to work as individuals and in pairs, as groups both large and small and as whole class. Different groupings are decided on for a variety of purposes and tasks, matched to pupil's needs. Tasks are planned as mainly practical activities which are balanced between investigations, problem-solving activities, oral and mental mathematics, consolidation and practice''. (Suzanne Edwards, 1998). One can understand the significance of the study from its curricular and educational implications. The existing sophisticated mathematics curricular practices in our schools are based on modern approach to mathematics education. The shift from traditional mathematics curriculum to the modern is not a spontaneous phenomenon. One has to understand this transformation from a wider socio-cultural framework of thoughts. According to Janet Lerner (1988), “Modern math’s approach neglected some of the psychological aspects of learning”. For many students with mathematics learning disabilities, “modern math” was inappropriate and compounded their mathematics problems. Modern mathematics curriculum could not do justice in learning institutions but created gaps in children’s understanding. For many students mathematics is the major area of difficulty. Mathematics learning is a complex enterprise. It is very difficult to understand why children fail in mathematics. Further, mapping the learning difficulties and a related conceptual disturbance is not an easy task. The reasons behind success and failure in learning mathematics are a function of number of cognitive and non-cognitive factors (Becker JR 1981, Fennema E, Sherman J 1978, Jacobs JE, Eccles E 1985). A number of factors like Linguistic abilities, Conceptual abilities, Visual – spatial abilities and Memory abilities play a role in mathematics learning. The most important significant dimension of this work is to understand the bearing of this work on the enterprise of cognitive science research in mathematics. A cursory look at the existing research on children’s learning reveal the disappointing and also challenging aspects (OEEC 1961). Apart from the general lack of a scholarly educational tradition, the inadequacies of such study come about because of the fear of approaching such a complex area as children’s inner lives. Instead of answering curiosity with observation, much educational research has attempted to reduce the problem into the simplistic solutions, by isolating a particular hypothesis and trying to prove it, or by trying to focus on what is easy and empirical. This discussion makes us realize the importance of research in mathematics education.

CONCEPTUAL – FRAMEWORK

The conceptual framework of the problem is studied with respect to the following two dimensions.

1. The content of mathematics with special reference to statistical techniques like diagrams and graphs.
2. Children learning of mathematics with special reference to developmental – cognitive processes of learning.

The operational definitions

In this section some of the difficult and new concepts/terms used in this study are explicated.

Representation: One of the most important aspects of scientific thinking is concerned with the representation of the given data. In other words, representation is the most seminal and foundational element of scientific inquiry. Children’s representative abilities determine their explanatory, descriptive and predictive capabilities. For the purpose of this study representation is construed in terms of presenting the given data into geometrical graphs.

Interpretation: One of the most desirable fruits of scientific activity is interpretation. Interpretation extends our knowledge to new situations. One’s ability of interpretation depends on one’s ability of representation. In this study the notion of interpretation has been construed in terms of constructing explanations about geometrical graphs by school children.

Sex background of the children: Sex is one of the important variables, which determine one’s perceptions and concepts about the world and reality. Indian society, no doubt, is hierarchically organized and it is a place of growing inequalities since their birth children are given preferences sex-wise, in providing facilities by their parents. To some extent the educational institutions also differentiate children with sex discrimination while handling their subject matter. This is more visible when the subject mathematics is dealt. In the light of this discussion it is felt necessary to include sex background of children as one of the independent variables to study its influence on children’s abilities in mathematics.

Management of the school: One of the important factors, which affect the abilities of children in mathematics, is the type of school. The growth and development of potentialities depends on the type of experiences the child encounters in the school environment. Generally schools differ in providing such facilities and creating congenial environment basing on the type of their management. There is a considerable difference between government schools and private schools with reference to the environment and facilities extended. Hence, it is felt necessary to include "Management of the school" as one of the independent variables to study its impact on the abilities of children in mathematics.

Parental educational background: It is a known fact that, parent's aspirations and expectations have a direct bearing on their children's education. An educated parent is aware of and can understand the strengths and weaknesses of their children and thus, they can provide necessary guidance and extend timely help. Hence in the present study parent's educational background is taken as one independent variable where parent's educational background is conceived in four levels basing on the degree of variance in their educational background.

Social background: One of the important factors of the Indian society is its caste-class dynamics. Caste consciousness reflects in day-to-day life activities, structures, people thinking institutional functioning and social activities. Children's abilities of understanding and interpreting mathematics are not independent of such dominating institutionalized caste consciousness. Therefore, it is desirable to include "Caste" as one of the independent variables to study the children's abilities in understanding and interpreting geometrical and statistical graphs.

Level of income: Generally people look at the things according to their socio-economic status. Economic status provides freedom to think, to express and to interact with others confidently. A person can acquire rich and varied experiences if he is economically sound. It is believed that economic factors structure one's thinking and shape one's abilities of understanding the world. Therefore, it is felt necessary to study "level of income" an independent variable to assess its influence on the children's abilities in mathematics.

Verbal to Symbolic (v-s): Mostly in mathematics problems are given in verbal form. One way of solving these problems is by writing them in the form of equations by using symbols. Making use of symbols makes a problem easier to solve. Using symbols solves most of the problems in geometry and statistics. One of the objectives of this study is how far the respondents are able to translate verbal problems in geometry and statistics into symbolic form.

Verbal to Graphical (v-g): Problems of geometry and statistics can also be solved by using graphs. Solving problems through graphical method and arriving at solutions is easier than other ordinary methods. A glimpse at the graph gives us an idea about it. Verbal problems in geometry appear to be abstract but one's they are represented in graphical form it would become easy to comprehend and can easily be interpreted and explained.

Graphical to Symbolic (g-s): The day-to-day life activities and complexities are generally represented in the form of graphs. These graphs are related to sports, business economy etc. Similarly there are graphs which represent geometrical concepts also. To understand these graphs we have to know certain concepts is mathematics. We have to translate the information from graphs to symbolic form to get a clear view about it.

Graphical to Verbal (g-v): Problems given in graphical form can also be solved verbally. The extent of interpreting the graphs necessarily depends on one's ability of representing it. Graphs in geometry can be interpreted verbally. A cursory look at the graph gives us a picture about the data and this data can be understood once they are represented verbally.

Symbolic to Verbal(s-v): Most of the problems in geometry are in symbolic form. Changing them to verbal form can solve these. To solve the problems verbally by transforming them from symbolic forms, one has to have knowledge about all the concepts involved in it. Problems, which look abstract in symbolic form, look more meaningful once they are transformed to verbal form.

Symbolic to Graphical(s-g): Using graphs we can solve problems, which are in symbolic form. This method can be adopted both in geometry and statistics. To represent the concepts in graphical form one has to have knowledge about the graphs like coordinate axes, point etc. Once children are able to represent symbolic problems in graphical form we can say that they have the ability to translate symbols into graphs. It is also easier to solve problems by using graphical method and the respondent will arrive at a solution at a faster rate and with more precision by using graphs than by other methods.

Hypotheses

1) The type of management of the school does influence children's (student's) conceptions and abilities of interpreting geometrical graphs.
a. There is a difference between government school boys and private school boys with reference to conceptions and abilities to interpret geometrical graphs.
b. There is a difference between government school girls and private school girls with reference to conceptions and abilities to interpret geometrical graphs.
c. There is a difference between English medium government school boys and English medium private schools boys with reference to conceptions and abilities to interpret geometrical graphs.
d. There is a difference between Telugu medium government schoolboys and Telugu medium private school boys with reference to the conceptions and abilities to interpret geometrical graphs.
e. There is a difference between government English medium girls and private English medium girls with respect to their conceptions and abilities to interpret geometrical graphs.
f. There is a difference between Telugu medium government school girls and Telugu medium private school girls with respect to their conceptions and abilities to interpret geometrical graphs.
2) Sex of the children (students) influence their conceptions and abilities of representing and interpreting geometrical graphs.
a. There is a difference between government school boys and government school girls with respect to their conceptions and abilities of representing and interpreting geometrical graphs.
b. There is a difference between private school boys and private school girls with respect to their conceptions and abilities of representing and interpreting geometrical graphs.
c. English medium girls differ from English medium boys with respect to their conceptions and abilities to represent and interpret geometrical graphs.
d. Telugu medium girls differ from Telugu medium boys with respect to their conceptions and abilities to represent and interpret geometrical graphs.
3) The medium of instruction of the school has bearing on the conception and abilities of interpreting geometrical graphs.
a. There is a difference between English medium girls and Telugu medium girls with respect to their conceptions and abilities of representing and interpreting geometrical graphs.
b. English medium boys differ from Telugu medium boys with respect to their conceptions and abilities of representing and interpreting geometrical graphs.
c. English medium government school children differ from Telugu medium government school children with respect to their conceptions and abilities of representing and interpreting geometrical graphs.
d. English medium private school children differ from Telugu medium private school children with respect to conceptions and abilities of representing and interpreting geometrical graphs.
4) Parental education background influences children's conceptions and abilities to interpret geometrical graphs.
5) Caste background of children influences children's conceptions and abilities to interpret geometrical graphs.
6) Economic background of the children influences their conceptions and abilities to interpret geometrical graphs.

Independent Variables:

1. Type of the school [Govt./Pvt.] management
2. Gender background of the children
3. Medium of instruction of the children
4. Parental educational background
5. Social background of the children
6. Parental level of income of the respondent

Dependent Variables:

1. Children's ability to represent geometrical concepts through graphs.
2. Children's ability to interpret geometrical concepts through graphs.
3. Children's ability to translate geometrical concepts in verbal to symbolic forms.
4. Children's ability to translate geometrical concepts in verbal to graphical form.
5. Children's ability to translate geometrical concepts in graphical to symbolic form.
6. Children's ability to translate geometrical concepts in graphical to verbal form.
7. Children's ability to translate geometrical concepts in symbolic to graphical form.
8. Children's ability to translate geometrical concepts in symbolic to verbal form.

Sample

The techniques adopted in selecting the sample for this research work is multistage stratified random sampling technique. Here the sample comprises of 24 schools. In the first stage the schools are classified with reference to their levels of performance into 3 categories like high level of performance, medium level of performance and low level of performance. While selecting the schools care has been taken to see that under each level 8 schools are drawn. Out of these 8 schools, 4 belong to government management and 4 belong to private management. Further, these four schools under each management comprises of 2 English medium and 2 Telugu medium. Under each medium one boys school and one girl's school are selected. Then a total sample of 24 schools has been selected. From these schools 120 boys and 120 girls have been selected by following simple random sampling procedure, with an equal proportion from every category of school.

Development of the research tool

The study of children's conceptions and abilities to interpret geometrical concepts is a multi-dimensional complex enterprise. One has to locate and interpret these abilities in a wider conceptual framework. Further, there is no perfect and comprehensive tool, which can grasp all these dimensions. The realization of such methodological problematic made the researcher to discuss various issues related to the development of research tool, with a number of experts. The researcher met a number of teachers, educationists, psychologists and free lancers in different institutions of learning and research at various places and on the basis of the discussions held and also taking into consideration the critical reviews made on the past, present and contemporary literature in the field of mathematics education, a preliminary draft was prepared for re-discussion and re-appraisal. During the process of generation of the tool the researcher spent substantial amount of time with teachers for understanding the way they formulate ideas about math and knowledge in mathematics. The various dimensions and items of the tool emerged in the course of discussion was tentatively finalized for a pilot study. The tool constructed comprises two parts. The first part is concerned with the profile of the respondents. Certain important independent variables like gender, occupation, educational qualifications, type of institution where the respondent is studying parental educational background were also considered. The second part consists of items related to all the dependent variables identified for the purpose of the study. In the first phase of the development of the tool certain important dimensions of the dependent variables have been identified. And a set of items were constructed under each dependent variable. While constructing these items certain other variables like children's existing curricular standards, age, and cognitive development stage were also considered. Most of the items are related to everyday life activities of children. In the second phase of the development of the tool the above set of items were circulated among university teachers, teachers teaching mathematics at schools and teachers working in training colleges with mathematics subject. After taking their opinion certain questions, which were found to be ambiguous to the students, were eliminated and finally 6 items in geometry were retained. Under each such category again 6 items were included i.e. total to 36 items in geometry were considered. In the third phase of the development of the tool, the tool was administered on a group of 30 children for the purpose of standardization of the tool.

The standardization of the tool: In order to evaluate how well the tool does what it is intended to do, certain standardized procedures were adopted. The main concern in establishing reliability is an accurate

repeatability of scores overtime and parallel forms of a test. The best way to assess a reliability of a question is by comparing answers students give to it on one occasion with the answers the same students give to it a short time later. For a tool to be useful, it must be reliable. The coefficient of
reliability of questionnaire forms the basic index of reliability. It is based on self-correlation of questionnaire. In order to establish reliability of tool, Split-Half method was adopted. The Split-Half method estimate reliability by treating each of two or more parts of a measuring instrument as a separate scale. Since this method is based on a single shot approach many other limitations like errors due to repetition, laps of time etc., were arrested. And the other conditions like mental set of respondents, level of their motivation, emotional stability, distractions and accidents etc., were also properly checked and monitored. Good questionnaire must also be valid, meaning that it should measure the concepts that are intended to measure. And the researcher believes that the tool on hand will measure what is expected to measure. This indicates that:

i. The adequacy of the content was judged by the experts in the field of education.
ii. The items of the tool were selected on the basis of validity indices.
iii. The numbers of items are also adequate. Thus validity and content validity of the tool were fulfilled.

Since no study was available to the researcher on the conceptions and abilities to represent and interpret geometrical concepts the concurrent validity was not measured. Further, during the phase of review of literature the researcher could not find any study with well accepted and standardized tools for measuring these abilities of children. Thus on the basis of the results obtained in the pilot study and the reliability and validity measures calculated, the final form of the tool was prepared.

Scoring procedures

The final form of the questionnaire comprises about 36 items in the geometrical concepts. These items under 6 different categories are related to representation and interpretative abilities of children with regard to graphs. As stated above on the basis of the reliability and validity measures and the pilot study, the final form of the tool was administered to the entire sample drawn for this study. After collecting the data the responses of the children were evaluated, and scores were assigned for each item. The scores were analyzed with respect to the independent variables under study. The weight ages given to each question range from 4 to 1 i.e., it ranges in between maximum precision to minimum precision.

Levels of measurement and statistical techniques

Since the study of graphical representation and interpretation is complex, the data collected in the course of research work is mostly qualitative in nature. As discussed earlier that such study involves many conceptual interconnected entities which are not easily amenable for analysis and quantification. However, for the purpose of this study the tool was developed in such a way that it can capture the major convictions of the respondents. In other words, for the sake of analysis and interpretation the responses were collected in the quantifiable terms. Another purpose of such quantification of the data is to manipulate the data and to work out the underlying connections in the network of the responses. In order to measure the variables included in the hypotheses certain decisions were made regarding the nature and level of measurement. The investigator develops a set of measures that will render empirical observation in the form required by the research problem and the research design. Measurement in this work is viewed as a procedure in which one assigns numerals, numbers or other symbols, to empirical properties (variables) according to rules. The numerals were used for comparison, evaluation and the assessment of relation between various properties, or variables. The requirement of isomorphism between numerical systems and empirical properties or indicators of properties generated a distinct level of measurement or scales of measurement. What is important to note here is the statistical operations permissible on a given set of numbers or dependent on the level of measurement attained. In what follows, the level of measurement and the rationale of the operations that are permitted at that level is presented. As discussed earlier one of the important aspects of operationalizing concept is ascertaining the level of the measurement of the variables. Many different statistical tests can be computed, and which statistic to compute depends partly on the types of the variables being examined. Since this study is on the conceptions and abilities in graphical representation and interpretation of geometrical concepts of children, the variables are construed in terms of nominal scale.

In this study certain types of data was classified and differentiated into certain categories on the basis of qualitative differences. The data related to the respondents i.e., their gender background, educational qualifications, parental education background, type of institution is not related to any numerical or orderly fashion i.e., nothing about these categories are numeric. They are discrete group, which do not bear any magnitude relationships to one another. The second type of measurement in this work is concerned to the ordinal variables. The categories related to the variables in this work do not have any intrinsic numeric qualities. The respondents were asked to perform or solve a problem related to geometrical concepts. These responses are intrinsically ordered from most precision to least precision. The scale conceived with such type of data reflects only magnitude and does not possess the attributes of equal intervals or the absolute zero point. In this study the above two levels of measurements were considered and appropriate statistical procedures were identified.

Two types of statistics are applied for the sake of analysis and interpretation. Descriptive statistical methods applied to generate information related to interpretative abilities of children in mathematical graphs. Under this the statistical measures like percentages, means, and standard deviations are calculated. In order to test the hypotheses formulated inferential statistical techniques were applied. Among the important inferential statistical techniques the parametric tests like t tests with 58 degrees of freedom at .05 level of significance were applied and the non-parametric test (chi-square) was applied. The coefficient of correlations was also worked out to understand the relationships between different variables.

Graphical representation and interpretation of geometrical concepts vs. Type of School

As stated above children's abilities in graphical representation and interpretation of geometrical concepts was studied by a standardized tool consisting of 36 questions under 6 items. The responses were evaluated and the scores were assigned according to their abilities. The calculated mean and standard deviation values in 6 items are shown below.

Table 1.1: Mean and Standard Deviation Values of the Children in Graphical Representation and Interpretation of Geometrical Concepts with Respect to the Variable Type of School (Pvt. / Govt.)

Type of School	No. Of Children	V-S		V-G		G-S		G-V		S-G		S-V	
		X	S.D	X	S.D	X	S.D	X	S.D	X	S.D	X	S.D
Private	120	7.1	4.48	8.3	4.5	8.3	4.36	7.8	4.37	7.9	4.3	6.9	4.2
Government	120	6.4	3.45	8.4	3.2	7.5	3.62	8.6	3.52	7.9	3.3	8.1	3.58

Table 1.2

Type of School	No. Of Children	Mean	S.D.
Private	120	7.9	4.38
Government	120	7.8	3.44

The sample under study consists of 120 government school children and 120 private school children. The mean and S.D values for private school children are 7.9 and 4.38 respectively. In case of government school children the mean value is 7.8 and standard deviation value is 3.44. From the above data it is clear that private school children are relatively closer to precision in graphical representation and interpretation of geometrical concepts, compared to the government school children. The variation in private school children is slightly higher than government school children. In order to test the hypothesis related to this variable chi-square analysis is computed at .05 level of significance and 2 degrees of freedom and the findings are discussed below.

Graphical representation and interpretation of geometrical concepts vs. gender of the respondents

From the below table it is clear that the mean value of boys related to graphical representation and interpretation of geometrical concepts is low compared to girls. And the variation in boys is high com-

Table 1.3: Mean and standard deviation values of the respondents in graphical representation and interpretation of geometrical concepts with respect to gender as one of the variable.

Type of School	No. Of Children	V-S		V-G		G-S		G-V		S-G		S-V	
		X	S.D	X	S.D	X	S.D	X	S.D	X	S.D	X	S.D
Private	120	6.5	4.06	7.9	3.98	7.5	3.87	7.9	4.2	7.9	3.84	7.2	3.97
Government	120	7.0	3.94	8.8	3.86	8.2	4.14	8.6	3.7	7.9	3.9	7.8	3.84

Table 1.4

Gender	No. Of Children	Mean	S.D.
Boys	120	7.48	3.98
Girls	120	8.05	3.9

pared to that of girls. Therefore it is found that the performance of girls is better than boys in this ability. In order to test the hypothesis related to this variable chi-square analysis is computed at .05 level of significance and 2 degrees of freedom and the findings are discussed below.

Graphical representation and interpretation of geometrical concepts vs. medium of instruction of the children

Table 1.5: Mean and standard deviation values of the children in geometrical concepts with respect to the medium of instruction of the students

Medium of Instructio n	No. Of Child-ren	V-S		V-G		G-S		G-V		S-G		S-V	
		X	S.D	X	S.D	X	S.D	X	S.D	X	S.D	X	S.D
Telugu	120	7.1	3.92	7.5	3.87	7.3	3.96	7.3	3.85	7.2	3.8	6.5	3.79
English	120	6.4	4.07	9.1	3.97	8.5	4.05	9.1	4.08	8.6	3.94	8.5	4.01

Table 1.6

Medium of Instruction	No. Of Children	Mean	S.D.
Telugu	120	7.15	3.87
English	120	8.36	4.02

In the sample under study, there are 120 Telugu medium students and 120 English medium students. The mean and standard deviation values of Telugu medium students for their responses to items related to the geometrical concepts is 7.15 and 3.87. In the case of English medium students the mean and standard deviation values are 8.36 and 4.02. From the above data it is clear that English medium students are relatively close to precision in representing and interpreting geometrical concepts compared to the Telugu medium students. And the variation in English medium students is higher than Telugu medium students. In order to test the hypothesis related to this variable chi-square analysis is computed at .05 level of significance and 2 degrees of freedom and the findings are discussed below.

Graphical representation and interpretation of geometrical concepts vs. parental education background

In the sample under study, there are 19 children whose parents are illiterate and their mean is 5.6 and standard deviation is 2.9. The mean value of children with primary education parents is 6.4 and standard deviation is 3.4. There are 109 children with secondary education parents whose mean is 8.9 and standard deviation is 4.2. And there are 10 children with higher educated parents whose mean is 12.8 and standard deviation is 3.3. From this table it is clear that the responses of children belonging to high parental education background are close to the precision in interpreting and representing the geometrical

Table 1.7: Mean and standard deviation values of the children in geometrical concepts with respect to parental education

Parental Education	No. Of Child-ren	V-S		V-G		G-S		G-V		S-G		S-V	
		X	S.D	X	S.D	X	S.D	X	S.D	X	S.D	X	S.D
Illiterate	19	3.9	2.2	6.9	2.9	5.3	2.4	6.5	3.4	5.7	3.1	6.2	3.4
Primary Education	102	5.4	3.0	6.7	3.3	6.6	3.7	6.8	3.3	6.7	3.4	6.3	3.5
Secondary Education	109	8	4.6	9.7	3.6	9.2	4.0	9.4	4.3	8.7	4.4	8.6	4.2
Higher Education	10	12	3.7	12.8	3.0	13.1	2.5	13.9	3.9	12.6	3.8	12.4	3.5

Table 1.8

Parental Education	No. Of Children	Mean	S.D.
Illiterate	19	5.6	2.9
Primary Education	102	6.4	3.4
Secondary Education	109	8.9	4.2
Higher Education	10	12.8	3.3

concepts compared to the responses of the children of illiterate, primary and secondary educated parents. In order to test the hypothesis related to this variable chi-square analysis is computed at .05 level of significance and 4 degrees of freedom and the findings are discussed below.

Graphical representation and interpretation of geometrical concepts vs. social background of the children

Table 1.9: Mean and standard deviation values of children in geometrical concepts with respect to social background of the children

Social backgroun d	No. Of Childre n	V-S		V-G		G-S		G-V		S-G		S-V	
		X	S.D	X	S.D	X	S.D	X	S.D	X	S.D	X	S.D
OC	73	8.6	4.7	10.1	3.7	10.1	3.8	10.4	5.6	10.2	4.6	9.7	3.8
BC	99	6.5	3.6	8.7	3.8	7.5	3.9	7.9	3.4	7.5	3.7	7.5	3.8
SC	60	5.3	3.7	7.6	3.8	6.7	3.8	6.6	3.8	6.0	3.6	5.2	3.7
ST	08	3.5	2.2	5.6	3.4	6.3	3.5	5.4	4.2	5.6	3.4	4.4	4.1

Table 1.10

Social background	No. Of Children	Mean	S.D.
OC	73	9.9	4.4
BC	99	7.6	3.7
SC	60	6.2	3.7
ST	08	5.1	3.5

In the sample under study there are 73 children who belong to forward caste whose mean is 9.9 and standard deviation is 4.4. There are 99 children belonging to backward caste whose mean is 7.6 and standard deviation is 3.7. The sample consists of 60 scheduled caste children whose mean is 6.2 and standard deviation is 3.7 and there are 8 scheduled tribe students whose mean are 5.1 and standard deviation is 3.5. From this data it is clear that children belonging to forward caste (OC) are close to precision in graphical representation and interpretation of geometrical concepts compared to the students belonging to backward case (BC), scheduled caste (SC) and scheduled tribe (ST) category. In order to test the hypothesis related to this variable chi-square analysis is computed at .05 level of significance and 6 degrees of freedom and the findings are discussed below.

Graphical representation and interpretation of geometrical concepts vs. parental level of income

Table 1.11: Mean and standard Deviation values of children in geometrical concepts with respect to level of income of the parents (low/medium/high)

Level of Income	No. Of Children	V-S		V-G		G-S		G-V		S-G		S-V	
		X	S.D	X	S.D	X	S.D	X	S.D	X	S.D	X	S.D
Low	197	6.2	3.8	7.6	3.8	7.4	3.8	7.7	3.9	7.2	3.7	7.0	3.9
Medium	41	9.4	5.2	10.6	3.6	10.6	4.0	10.6	4.2	9.8	3.9	9.4	4.1
High	02	5.5	1.5	14.0	3.0	10.5	6.5	9.5	0.5	12.5	3.5	10.5	4.5

Table 1.12

Level of Income	No. Of Children	Mean	S.D
Low	197	7.2	3.8
Medium	41	10.1	4.2
High	02	10.4	3

In the sample under study there are 197 children belonging to low level of income, 41 children of medium level of income and 2 children of high level of income. The mean and S.D values of children belonging to low level of income for their responses to items relating to geometrical concepts are 7.2 and 3.8. In the case of children of medium level of income the mean value is 10.1 and SD is 4.2. And for the children belonging to high level of income the mean value is 10.4 and SD is 3.2. These results reveal that the children belonging to medium level of income are close to the precision in graphical representation and interpretation of geometrical concepts when compared with the children of low level of income. It is also observed that the responses of the children belonging to high parental level of income group are very close to the precision but they constitute only 2 members. In order to test the hypothesis related to this variable chi-square analysis is computed at .05 level of significance and 4 degrees of freedom and the findings are discussed below.

Findings related to children's conceptions and abilities in graphical representation and interpretation of geometrical concepts

1. Private school children are relatively closer to precision in graphical representation and interpretation of geometrical concepts.
2. It is found that there is a relationship between the type of school and ability to represent and interpret geometrical concepts through graphs.
3. It is observed that there is no significant difference between boys and girls with respect to their ability in graphical representation and interpretation of geometrical concepts.
4. It is found that there is no relationship between sex background of the children and abilities in graphical representation and interpretation of geometrical concepts.
5. Compared to Telugu medium student's English medium students are relatively closer to precision in graphical representation and interpretation of geometrical concepts.
6. It is found that there is a relationship between medium of instruction of the students and ability in graphical representation and interpretation of geometrical concepts.
7. It is observed that there is a relationship between parental education background and students' abilities in graphical representation and interpretation of geometrical concepts.
8. It is found that children's social background has an impact on their abilities in graphical representation and interpretation of geometrical concepts.
9. Parental level of income has an impact on children's abilities in graphical representation and interpretation of geometrical concepts.

DISCUSSION

The primary objective of this study is to draw inferences from the major findings, which is about children's conceptions and abilities related to certain mathematical ideas and operations. As discussed in earlier, the sample selected for the purpose of the study represents the population of the present investigation. Further the standardized tools of the study have become instrumental in drawing logical inferences from sample to population. Though inductive reasoning plays a significant role in this process of arriving at generalizations, the researcher has gone beyond such narrowly construed logic-methodological steps by exploring certain qualitative dimensions of the problem. As mentioned earlier this study grappled one important aspect which is "Children's conceptions and abilities on graphical representation and interpretation of geometrical concepts".

The analyses of the data collected from children revealed that majority of children do not have adequate understanding about geometrical concepts. It is observed that while solving the problems children were more concerned about what to write on the paper rather than understanding the words and intricacies of the given problem. They never bothered about reading the given problem, but attempted to experiment with their naïve conceptions and techniques of problem solving. One of the reasons could be the dominance traditional mathematics instruction in the schools selected for the study. Such conventional instruction is centered on conveying information from teacher or textbook to student i.e., the teacher or textbook attempts to give knowledge to the students rather than encourage the student to construct knowledge on his or her own. The students are taught methods of doing problems without being taught why the methods work. It is also observed that there is too much of emphasis on memorization of facts and procedures. The other important reason could be the way the mathematics teaching marginalizes everyday life activities. No attempts are made in the schools to map mathematical concepts and procedures to real world relationships. Mathematics classrooms under such tradition procedures provided training in procedural logics of mathematics problem solving. One of the reasons why the respondents of the sample were not keen in reading the mathematical problems presented in words could be due to the fact that school mathematics language is substantially formal in its approach, which is significantly different from home language. The other reason may be that mathematical thinking is a hierarchical conceptual system. In order to represent the given problem child has to move from simple to complex conceptualization and abstraction. Since children are not trained properly and adequately in such modes of conceptualization, they try to withdraw from representing the various problems or given tasks in verbal form. As a diagram / picture give a better understanding of a problem / concept than words, it is found that children could interpret graphical problems better than verbal or symbolic problems. It is also found that children studying in private schools are relatively closer to precision in graphical representation and interpretation of geometrical concepts. The reasons for this could be that these children come from good economical background and they are not the first generation learners. Their parents are educated and they get enough motivation to learn. Whereas children studying in government schools are first generation learners. Majority of them earn for their livelihood and then go to schools. They are less motivated and their parent's interest on their education is very minute. Apart from this the environment or the surroundings where they live also influence their interest in learning. It has been found that the type of school management plays a significant role in shaping the abilities of school children. School effectiveness represents its clientele. The school infrastructure facilities, teacher resources, student teacher and parent relationships, school environment and organizational climate do influence children's abilities of understanding. It is difficult to expect good results of performance from children of poor or ill-equipped schools. Some of the government schools selected under the sample do not have minimum requirements like proper space, ventilation, sanitation, etc. In contrast to this in the sample selected there are schools, under private management, with sufficient infrastructure facilities and teacher resources. Due to such school infrastructure facilities and learning environment children perform better in these schools compared to children belonging to ill-equipped schools. Actually speaking, management relations play a seminal role in creating a space for children's activities and the production of knowledge. The schools which are very sound in infrastructural facilities, teacher resources and proper school climatic conditions, generally, motivate children to develop their abilities of understanding. In general, educational institutions, under private and government managements differ widely in terms of financial resources, human resources, laboratory facilities, infrastructure facilities, organizational structure, institutional climate and working conditions play a vital role in positioning the children in their respective institutions. Every institution functions on certain beliefs and values, which are institutionalized through certain specific practices of rationality. Institutional agendas exclude certain discourses and emphasize certain other discourses. Therefore institutional practices can be understood by inquiring into how certain rationalities are negotiated and institutionalized.

An ongoing argument in educational circles concerns whether or not women's under representation in science and technical careers is somehow related to cognitive differences between the sexes, which are genetic in origin. Concern about occupational segregation has led to increased attention to factors, which contribute to that segregation, and sex-related differences in school mathematics have emerged as a major issue. As boys have different social experiences than girls, and since the ability and inclination to think mathematically accrues as a consequence of experiences, boys and girls would be expected to exhibit differences both in attitude and cognitive functioning. In the present study though it was found that there was no difference between boys and girls with respect to their abilities in graphical representation and interpretation of data, even then it was found that there is a variation in problem solving and reasoning abilities between boys and girls. Boys are found to be superior in their performance compared to girls. Mathematics achievement is portrayed in our society is a 'masculine' field of endeavor, hence boys are motivated to achieve competence as a part of their developing masculinity and girls are motivated not to achieve competence in order to be more feminine. Moreover, theories of sex-role socialization and modeling predict that girls' self-confidence as learners of mathematics is undermined by role models who depict mathematics as an inappropriate achievement domain for females. Even when there are no sex differences in actual performance, girls expect to do more poorly than boys and evaluate their performance more negatively. This is particularly true on tasks, such as visual-spatial tasks, on which males are alleged to excel. If was found in the study that gender differences did occur in mathematics achievement. Although the differences were not large, they were pervasive and favored boys. Differences between the sexes in mathematical conceptions and abilities are not immutable, and provide empirical evidence that non-biological factors play a role in determining the magnitude of gender differences. Background experiences, accumulating effects of sex-role requirements, and the training which students receive in school mathematics may collectively account for a significant portion of the gender disparities. Given the complexity of the issue, it is not likely that precise explanations for differential achievement in mathematics will be provided in the near future. At this time, it appears that a number of biological and psychosocial explanations may all be correct. Whatever the precise explanations may be, those attempting to meet the educational needs of girls-parents, teachers, and policy-makers can take heart in the fact that biological predisposition is not of a magnitude that could account for the large disparities in male and female representation in mathematics-related classes and careers. Moreover, close attention to experiential and psychosocial factors operative in the lives of young girls can dramatically influence girl's achievement in mathematics.

It has been found through chi-square analysis that children having higher parental education background have better conceptions and abilities in graphical representation and interpretation of geometrical concepts. Parental education background influences children in many ways. Educated parents, generally, discuss with children and try to develop their level of awareness. Their interaction with their children may be implicit or explicit in their actions. In highly educated families children get ample opportunities to read, write and speak on many occasions. Educated parents try to identify the needs of the children and accordingly they try to provide the various means to reach certain goals. In other words, the educated parent's carrier orientation, goal fixation and continuous counseling help children to move in a particular direction. Such parental care and guidance create a space for them to act according to the demands of the institution. By and large, educated parents are very keen followers of social trends with respect to the preferences of future profession of their children and the corresponding dimensions of educational attainment. They generally adhere to the institutional frameworks and create such an atmosphere where children are motivated to move in the direction for the goal attainment, which is in accordance to the expectations of their parents. In some families parents provide tuitions to children and in some other families parents themselves provide regular guidance at home. Apart from this individualistic attention, educated families equip their homes with various academic oriented things like story books, novels, magazines, and science and math books for children, encyclopedias, etc. Most importantly parent's discussions with children allow them to clarify their doubts and enrich their knowledge, what is important to note here is most of such interactions in educated families are centered around text-books and disciplines. Educated families social network is another important aspect which contributes for the development of children's abilities of understanding different concepts. Parents with good academic background mostly invite and visit people of similar background. The point here is the process of socialization in educated families greatly influences in installing certain values and inculcating certain attitudes among children. Children with such family background take school activities seriously and perform them in a disciplined way. In contrast to the educated families, the uneducated families, due to the priorities they fix up in their life and due to their nature of work, do not show any serious concern about their children's academic growth. Parents with low level of education do not take seriously their children's academic progress and advancement. The world they conceive do not go beyond certain limits. Due to the lack of linguistic and non-linguistic abilities and skills they do not interact much with the children as far as academic matters are concerned. In such cases children totally depend on school teachers. They do not get congenial atmosphere at home to do their academic activities. Whereas the parents who are educated are seriously concerned about their children's education. They continuously watch their children's actions and behavior at home and also at the institution. They regularly meet school authorities to check their children's progress and performance. Actually speaking mathematic reasoning and creative thinking among children can be developed by exposing them to different situations depicting natural events and occurrences. But in the families with low education levels people are concerned mostly with economic problems and other social rituals and religious practices. Therefore, children belonging to such families do not find any opportunity to think critically on academic matters unlike educated families, the parents with low educational background generally do not fix the goals for their children and they are not career oriented. Their objectives of life are not directed towards certain end points. The lack of such goal formation abilities effect the children's perceptions and future activities. Children in such families are crippled in many ways for example; they cannot formulate high aspirations and positive attitudes towards academic institutions. In the light of above discussions one may conclude that parental educational background is one of the important determinants which influence children's conceptions and abilities of graphical representation and interpretation of geometrical concepts.

From the chi-square tests it is found that there is an association between socio-economic background of the children and their abilities in graphical representation and interpretation of geometrical concepts. From this study it is evident that children of forward caste are superior with respect to their abilities in graphical representation and interpretation of geometrical concepts. The reasons behind this fact may be due to the cultural and social background of forward caste. Children of forward category are in an advantageous stage because of their position and location in the social hierarchy and cultural relationship. By virtue of their position in the society they get ample opportunity in getting varied experiences related to graphs. Majority of the forward caste families compared to families of other categories belong to high or medium income groups. Due to such background they get an opportunity to provide minimum basic requirements for the children i.e., a place or a room to read with proper lightening and ventilation facilities and other related material for academic purposes. Apart from this, these families also provide children with proper literature and equipment. No doubt the material strength and the possession of other required aspects for study instill confidence and make them acquire knowledge about mathematical concepts and graphs. Unlike OC's, many of BC's, SC's and ST's who belong to the lower levels of social strata generally do not encourage their children towards academic activities. Children belonging to these communities are poor compared to the other communities because of many reasons. Firstly, due to their low levels of social background they do not get proper recognition neither in the school nor in the community. Majority of these children are poor and socially disadvantaged. They are culturally inscribed in certain rigid religious practices, rituals, superstitions and false-beliefs are common. Such social background creates a particular social space for children to think and act. Most of them are not like children belonging to OC communities in reasoning and interpreting mathematical concepts. In the light of the above discussion one can note that the socio-economic background of school children is one of the important factors which influence their abilities in graphical representation and interpretation of geometrical concepts.

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