

**A DIAGNOSTIC STUDY OF ERRORS COMMITTED BY 8TH GRADE STUDENTS OF GOVERNMENT SCHOOLS
IN SOLVING PROBLEMS OF GEOMETRY.**

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ABSTRACT

Mathematics plays an important role in accelerating the social and economic growth of the nation. It is more so in India, as nation is rapidly moving towards globalization in all aspects. The world of today, which learns more and more heavily on science and technology, demands more and more mathematical knowledge on part of its people. It is, therefore, necessary to prepare the child with a strong base of mathematical knowledge to face the challenge of modern technological society. Besides Arithmetic and Algebra, Geometry is another branch, which dominates the learning of mathematics in higher classes. Whereas Arithmetic and Algebra both are the science of number, Geometry is the science of lines and figures. The world of mathematics is the world of measurement. The process of measurement is incomplete without Geometry. This study is an attempt to find out the errors committed by eighth grade students in solving problems in Geometry. The objective of the study is to identify the difficulties faced in learning of Geometry by eighth grade students, to find out the errors committed by students in translating statements in mathematical form using appropriate diagram, and to suggest remedial programme for eighth grade students for learning of Geometry. In this study sample of 150 students of government schools were selected randomly for collection of the data. The investigator herself made a diagnostic test consisting of 3 subsets of 12, marks each i.e. angles, quadrilateral, and triangle. Study revealed that students command on Geometry was not satisfactory. They committed above 60% errors in every section which indicate that their basic concepts were not clear. Concepts are formed at primary stage and perhaps they did not have adequate opportunity to draw figures, to understand the concepts, to observe things themselves at that stage. It partially suggests that teachers at Primary Stage do not use Analytic Approach properly.

KEYWORDS- Analytic Approach, Geometry, Mathematics, Solving Problems.

INTRODUCTION

Each individual has his own ability, interest, aptitude, attitude, creativity, and feelings etc. towards a particular subject. There can be no two opinions that education is the key to the development of nation and a catalyst for national integration. Mathematics has both competencies of its own and use as a tool in science, technology and everyday living. The ability to count, measure, deal with numbers and symbols is of great importance to civilized man. It is reasonable to draw the inference that mathematics is instrument of education found to be in keeping with human mind.

Education plays very important role in our society, needs and aspiration. Society effects in school activities and vice versa. In other words school is a sub social system. School and society act and interact with each other. School is most important and popular source of providing education. So school curriculum must be effective. Mathematics taught as compulsory and important subject in schools.

During the age of education 3R's, mathematics was one of the three, rather two subjects of study; its importance in present age is no less. There can be no schooling without mathematics.

The dictionary meaning of mathematics is that it is either science of number and space or the science of measurement, quantity, magnitude. It is a systemized organized and exact branch of science. It deals with quantitative fact, relationship as well as with problem solving space and form.

Mathematics is defined in different way by different authors:

“The science of indirect measurement.” (Comet)

“Mathematics is queen of science and Arithmetic is queen of all mathematics.” (Gauss)

“Mathematics is gateway and key to all Science.”

“Mathematics is language in which God has created the world.” (Galileo)

Importance of Mathematics in School Curriculum

Plato advocated the inclusion of Mathematics in school curriculum because Mathematical reasoning disciplined the mind.

“It is only subject that encourages and develops logical thinking. It enables the student to discriminate between essential and none essential. It helps them to understand facts, to draw conclusion tersely and without ambiguity and that it is a subject by which they may learn what is meant by rigid reasoning.” - Kothari commission.

Kothari commission emphasized the significance of mathematics in school curriculum by stating “one of outstanding characteristic of scientific culture is quantification mathematics, therefore assumes a prominent position in modern education.”

“The average citizen has but little need of mathematical fact, or even opportunity to use them beyond the merest element of arithmetic.” (Yond)

“If mathematics, however, had no value as a mental discipline, its teaching in secondary school could hardly be justified solely on ground of its bread and butter value.” (Herbart)

Geometry: An important branch of Mathematics

Besides Arithmetic and Algebra, Geometry is another important branch which dominates the learning of the mathematics in high school classes, whereas Arithmetic and Algebra both are science of numbers; Geometry is science of lines and figures.

Geometry has been derived from Greek word “**geo**” and “**metrein**” which means ‘the earth’ and ‘to measure’ respectively. The use of Geometry began a long time ago when men felt the need to measure the land. The Geometry originally meant measurement of earth.

The Geometry is a part of mathematics concerned with Question of Size, shape, relative position of figure and properties of space.

The Geometry is one of the oldest sciences in ancient India. Vedic rituals such as yogas and yajanas required the construction of place for scared fire, known as Agnikunda. These Agnikunda were in the regular figure. So the idea of form figure and necessarily for measurement has been there since long.

In Geometry, we learn how to construct such figures and understand their basic properties like position, shape, size, and their relation to one another. Hence Geometry is science of properties and relations of lines, surface and solid in space.

To meet the objectives of teaching Geometry in secondary schools, the functions of secondary schools are:

1. To systematize the information received by the pupil in the pre school stage and extend it to some of the broader and more general aspects of Geometry of everyday life.
2. To aid the pupil in becoming familiar with the basic Geometry concepts and space perception and understanding the fundamental techniques such as use of straight edge, protractor or compasses and the techniques of direct and indirect measurements and construction.
3. To acquaint the pupil with good geometrical notation.

NEED OF THE STUDY

Geometry is recognized as a study important for cultural development. It is the key to mathematical thinking. Its importance arises partly from its value in demonstrating the nature and power of pure reason. On the basis of a few axioms or assumptions, the student is able to erect a logical structure of established truth that can be used to discover and prove new facts. It provides content that range from simple to complex. The results are verifiable as correct or incorrect.

Technical advances have placed an increasing importance on Geometry of form, size and position not only in engineering, machine shop and construction industries, but in landscape, architecture, interior decoration and area of appreciation.

Further for a sound foundation in teaching Geometry a teacher has to be well versed with all possible errors which can be committed by students in learning Geometry. Hence it is necessary that teacher must have the prior knowledge of errors and their remedies.

OPERATIONAL DEFINITION OF THE TERMS USED**Errors**

Errors mean mistakes made by someone.

Problems

A thing that is difficult to deal or to understand.

Diagnostic Test

Diagnostic test in education referred to the process of discovering through tests, interview and case study, the causes and nature of adjustment problem of an individual, when specially applied to the teaching learning process, it has different meaning. Educational diagnosis implies the use of procedures designed to locate specific and instrumental difficulties and if possible to determine their causes.

Geometry

Geometry is all about shapes and their properties.

Plane Geometry

Plane Geometry is about flat shape like line, circle and triangle etc. figure that can be drawn.

Solid Geometry

Solid Geometry is about three dimensional objects like cube, pyramids etc.

OBJECTIVES OF THE STUDY

1. To identify the learning difficulties in Geometry faced by 8th grade students.
2. To find out the errors committed by students in translating statement in mathematical form using appropriate diagram.
3. To suggest remedial programme for 8th grade students in learning of Geometry

RESEARCH METHODOLOGY

"Research design is a choice of an investigator about the components of his projects and the development of certain components of the design".

"If the scholar cannot describe his method, the chances are that it is too vague and general to yield him satisfactory results."

T. H. Hillyay

The first task of the investigator is to select an appropriate methodology for research. Research methodology involves the systematic procedure by which the researcher starts from the initial identification of the problem to its final conclusion. The role of methodology is to carry on the research. There are various ways and means of collection, analyzing and responding data depending on the problem. There are mainly three types of method in research:

- **Historical Method**
- **Experimental Method**
- **Descriptive Method**

The decision of the methods depends upon the nature of the problem selected and the kind of data necessary for its objectives. In the present study the "Survey Method" under the head of Descriptive Method, was used to collect data regarding the learning difficulties in Geometry. Survey Method, in its simplest form, is concerned with those techniques and procedures which are used to ascertain and establish the present status of things, situations, communities, individuals, groups, systems, relationships, attitudes, objectives, trends, conditions or any other phenomenon. The primary concern of this type of research is present and not past or future. This method is not only concerned with collection of data, it includes measurement, classification, analysis, comparison and interpretation. In this survey, the researcher used diagnostic test to collect data from selected groups by following appropriate sampling procedure.

POPULATION AND SAMPLE

POPULATION

The term 'population used in research is to describe any group of people or observation with which the researcher is concerned.

"A population is the totality of objects under consideration."

A.C. Rosender

A population is any group of individuals that have one or more characteristics in common that are of interest to the researcher. It means all those people or documents etc. that are proposed to be covered under the scheme of study. A population may be defined as an aggregate of items possessing a common trait or traits. It is the totality of objects under consideration. Population is used in research to describe any group of people or observation in which the researcher happens to be concerned on the basis of objective. The Government school students of class VIII of Roorkee city constituted the population for the purpose of the present study.

SAMPLE

It is not possible for any researcher to collect data about the whole of population in any investigation. He has to take a selected group from whole of population for his research work.

Sampling is the process by which relatively small number of individuals or measures of individuals, objects or events is selected and analyzed in order to find out something about the entire population from which it was selected. It helps to reduce expenditure, save time and energy, permit measurement of greater scope, or produce greater precision and accuracy.

The representative proportion of the population is called a sample. To obtain a representative sample, researcher selects each unit in a specified way under controlled conditions. Usually four steps are involved in the process.

- **Defining the population**
- **Listing the population**
- **Selecting a representative sample**
- **Obtaining an adequate sample**

The sample has been defined as 'a miniature picture of the entire group of aggregate from which it has been taken'. In other words, it is a small representation of large whole. In other words, a sample is that part of the universe which we select for the purpose of investigation. A sample should exhibit the characteristics of the universe; it should, be a 'microcosm' a word which literally means 'small universe'.

"A sample as the name implies, is the smaller representation of a larger whole."

Hellway Thrus

A sample may be described as a part of large number and the process of sampling means, gathering information from the sources which tend to form a cross section or representative sampling of the entire group from which, if time and expenses permitted, it would be desirable to obtain.

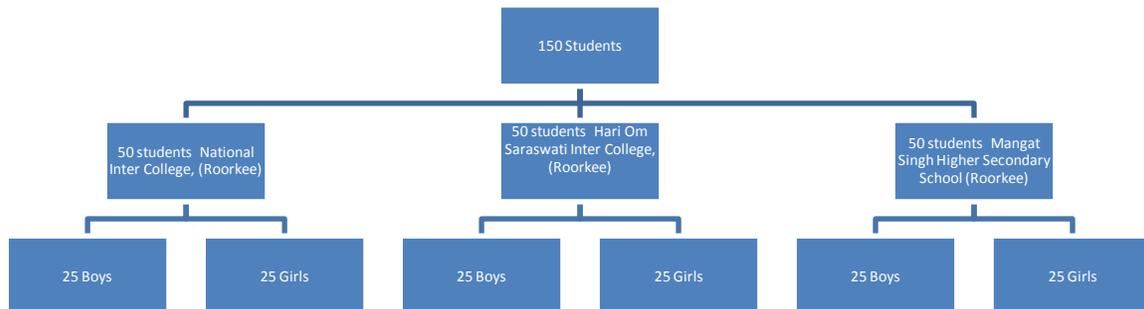
Sampling is an important factor in every sort of research. The process of sampling in survey means gathering information from many sources. Sampling keeps selecting representative group from the whole population and then with the help of appropriate techniques the researcher becomes able to draw inferences about the entire population.

SAMPLE DESIGN

The careful selection and design of sample is of prime importance for any kind of research activity which involves use of a sample. The design of the sample for the study conducted is shown in Figure 1.0.

Figure 1.0

SAMPLE DESIGN



METHODS OF SAMPLING

Sampling methods can be classified into broad categories

1. **Non-Probability Sampling**
2. **Probability Sampling**

Non probability sampling: In Non-probability sampling, the units are selected at the discretion of the researcher. Such samples use human judgment in selecting unit and have no theoretical basis for estimating population characteristics.

Probability sampling: In Probability sampling, the units of the population are not related at the discretion of the researcher, but by means of certain procedures which ensures that every unit of population has one fixed probability of being included in the sample.

The stratified random sampling method was used in this study. In this study sample of 150 students of Government schools were selected randomly for the collection of data.

SAMPLE TAKEN FOR THE STUDY:

The sample taken for the study is shown in Table 1.0.

Table 1.0

SAMPLE FOR THE STUDY

Name of the school	No. of students
National Inter College	50
Mangat Sigh Higher Secondary School	50
Hari Om Saraswati Inter College	50

TOOLS USED FOR DATA COLLECTION

Like the tools of carpenter's box, each research tool is appropriate in a given situation to accomplish a particular purpose.

A researcher will require many data-gathering tools or techniques which may vary in their complexity, design, administration and interpretation. Each tool is appropriate for the collection of certain type of evidence or information. The researcher has to select from the available tools, which will provide data, he requires for the testing of the hypothesis. In some situations the researcher may find that the existing research tools do not suit his purpose and so he may have to modify them or construct his own. For this the researcher should familiarize himself with the nature, merits and limitations of the existing research tool and should also develop skill in the construction and use of each of these research tools.

The major data-gathering tools of research may be classified broadly in to the following categories:

- Psychological tests
- Inquiry forms
- Observation
- Interview
- Sociometric Techniques.
- Questionnaire

The selection of suitable tools is of vital importance for successful research. Keeping in view the requirement of the study, the investigator used the following as tool for data collection

- **A self-developed diagnostic test.**

CONSTRUCTION OF DIAGNOSTIC TEST FOR STUDENTS

The investigator herself made a diagnostic test consisting of 3 subtests of 12 marks each i.e. Angles, Quadrilateral, Triangles. The diagnostic test was developed in accordance with the syllabus prescribed for class VIII students. 60 questions were prepared in total, 15 questions in each part. In diagnostic test multiple questions (with 4 options) were used. This diagnostic test was also sent to subject experts to check its worth. With the help of subject experts and under the guidance of supervisor the ambiguous and similar questions were removed and then final diagnostic test was approved which had 12 questions for diagnose difficulties in learning Geometry.

COLLECTION OF DATA

The investigator personally visited the schools and explained the purpose of the diagnostic test. The general instructions to fill in the diagnostic test were explained by the investigator. The students of class VIII were taken into confidence. The attitude of the class VIII students was cooperative. They showed keen interest in the study and provide all possible help. The diagnostic test was direct and self-explanatory.

SCORING OF THE DATA COLLECTED

After the collection of data, all the booklets were scored by the investigator according to their respective procedure. There were 12 questions in the diagnostic test; each question is of 1 mark. 1 mark

is given for right option and zero mark is given for wrong response.

STATISTICAL TECHNIQUES APPLIED

The data obtained from diagnostic test was analyzed properly and simple percentage calculated by making use of simple percentage method.

DELIMITATION OF THE STUDY

1. The study is delimited to Roorkee city only.
2. The study is delimited to Government schools only.

ANALYSIS AND INTERPRETATION OF DATA

The analysis and interpretation of data has been done separately of students with the help of diagnostic test. Regarding learning difficulties in Geometry of class VIIIth students, 'Section A' deals with female students' responses in diagnostic test and 'Section B' covers boys' responses.

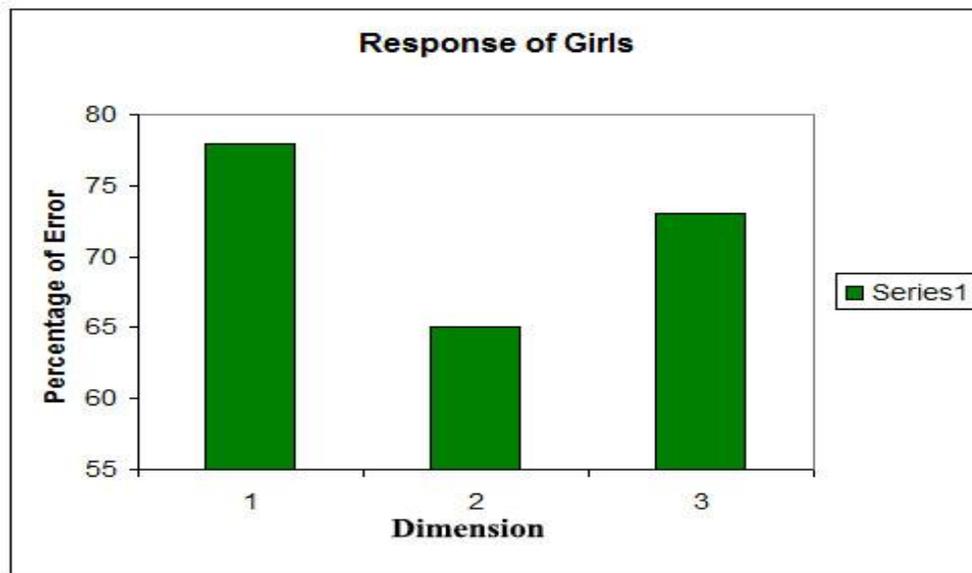
Section-A

Table 1.1

Responses of girls regarding difficulties in learning Geometry

Sr. No.	Dimension	Max. Error	Mean	% of Error
1.	Angles	701	9.35	77.91
2.	Triangles	590	7.8	65
3.	Quadrilateral	657	8.76	73

Figure 1.1



The diagnostic test of mathematics, consisting of 3 subtests of 12 marks each, was given to 75 girl students. The result of the test is shown in Table 1.1 and also graphically presented by Figure 1.1.

1. In the subtest given on the angles, the mean of errors committed by girls on angles is 9.35 which show that girls committed 77.91% errors. On the basis of result it is very clear that only 22.09% Correct responses were noted. Inferences drawn from above table are that girls command over study of angles is not satisfactory.
2. It is quite evident from the table, that the mean of errors committed by girls on subtest on triangle is 7.8 which shows that 35%. Correct responses were given by the girls. Therefore students command over study of triangles is not up to mark.
3. In the third subtest given on the quadrilateral, the mean of errors committed by students is 8.76 which show that girls committed 73% of errors in quadrilateral. On the basis of result, it is very clear that only 27%. Correct responses were noted. So it can be concluded that the girls command over study of quadrilaterals is poor.

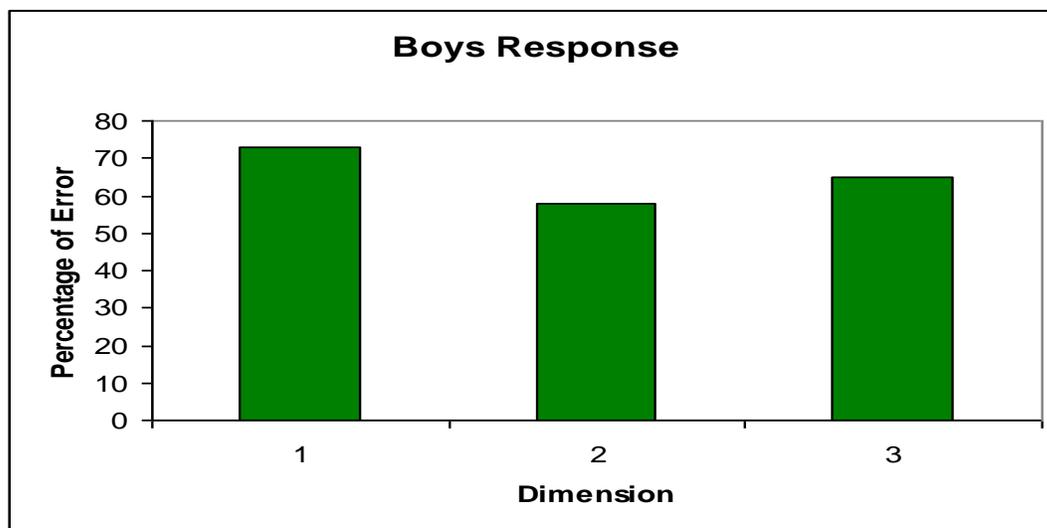
Section-B

Table1.2

Responses of Boys regarding difficulties in learning Geometry

Sr. No.	Dimension	Max. Error	Mean	% of Error
1.	Angles	656	8.75	72.83
2.	Triangles	523	6.9	58.11
3.	Quadrilateral	584	7.8	65

Figure 1.2



The diagnostic test of mathematics, consisting of 3 subtests of 12 marks each, was given to 75 boys students. The result of test is shown in Table 1.2 and also graphically presented by Figure 1.2.

1. The first subtest given on the angles, the mean of errors committed by boys on angles is 8.75, which show that boys committed 72.83% errors. On the basis of the result it is very clear that only 27.17% correct responses were noted. Inferences drawn from above table are that boys command over study of angles is not satisfactory.
2. In the second subtest on triangle, the mean of errors committed by boys is 6.9 which show that boys committed 58.11% errors. Result shows that 41.89% correct responses were given by the boys. Therefore students command over study of triangles is not up to mark.

3. In the third subtest given on the quadrilateral, the mean of errors committed by students is 7.8% which shows that boys committed 65% of errors in quadrilateral. On the basis of result it is very clear that only 35% Correct responses were noted. So it can be concluded that the boys command over study of quadrilaterals is poor.

MAJOR FINDINGS OF STUDY

Therefore major findings of the research conducted are as follows:

1. The students' command on angles is not satisfactory. The students committed maximum errors in angles. Both boys and girls committed around 75% errors but boys performed little better as compared to girls in angles.
2. Students' performance in triangles is not very much satisfactory; however in comparison to other areas of Geometry, students' knowledge about triangle is better. They committed around 62% errors in triangle and in this test performance of boys is better than girls.
3. The students face difficulty in quadrilateral. They committed around 69% errors in quadrilateral. So we can say student's knowledge about the quadrilateral not up to the mark. Here again, boys performed better than girls.

So we can conclude from the finding that students command on Geometry is not satisfactory. They made above 60% errors in every section. Their basic concepts are not clear. Concepts are formed at primary stage. Perhaps they do not get the opportunity to think, to draw figures, to understand concepts, to observe things themselves. Teachers do not use the analytic approach properly. Home work is also not checked properly.

EDUCATIONAL IMPLICATIONS

Mathematics is regarded as an important subject of study at all stages. According to National Policy of Education, Mathematics should be visualized as a vehicle to train a student in thinking, reasoning, articulating, logically. Mathematics education is probably the most important area concerned with the school education and its importance is vital for development of Science and technology. Mathematics is a part of universal education and the subject appears in curriculum of all students but students still have Mathematics-Phobia in their minds.

Arithmetic, Algebra and Geometry are three branches in Mathematics. Without making progress in Geometry a student cannot make progress in Mathematics. Due to importance of Geometry time has come for educationists to be aware of the need for multidisciplinary approach to teaching and learning Geometry at primary level. Coordinate and concrete efforts should be made on the parts of students, teachers, educational researchers and mathematician to tackle this fundamental problem. Findings show that problem less in concept in formulation at primary stage. Classroom sitting should be established in a concrete, significant situation. Experience is provided to develop generalization and the concept is applied to life situations. This research has educational implications for both students and teacher.

IMPLICATIONS FOR TEACHERS

The teachers must depend on first hand experience and visual aids, the blackboard must be used effectively for all theorems and originals. The figures must be sufficiently clear and accurate to avoid this distortion. Colored chalks may be used to emphasize significant details. Blackboard and instruments like compass, protector and ruler requires skillful handling. The room should reflect the spirit of Mathematics, pictures, models, exhibits and bulletin board should be brought into unified setting. The setting should be varied from time to time. The class should come to feel a part of responsibility for sitting slides, filmstrips and moving pictures serves a similar purpose. It is, therefore, following mentioned efforts are required from the part of teachers:

1. The teacher should depend on first hand experience and visual aids.
2. The practical work should be neat and evident.
3. There should be no oral teaching of definitions and memorizing of abstract ideas rather than pupils should be asked to observe things themselves by actual measurements or experiments.
4. The blackboard work should be satisfactorily, neat, clear and accurate to avoid doubts and misconceptions. The teachers should also insist upon the accuracy of language.
5. Analytical approach in the beginning should become a rule. Synthetic approach should not be applied unless and until the idea is thoroughly understood.
6. A proper atmosphere should be created in classroom by displaying suitable charts and models on subjects.
7. The subjects should be frequently correlated with arithmetic and algebra.
8. The riders should not be left to be done at the end of the session. They should be done side by side with theorems.
9. The hand of pupils should be trained to draw the figures for theorems and sides free hand and with case. But in the beginning all construction should be made with the ruler and compass.

IMPLICATION FOR STUDENTS

The major implications are as follows:

1. The pupils should write in their notebooks the few definitions they have to memorize.
2. Homework should be done regularly.
3. Pupils should express themes by drawing, by constructions and by words as fully as possible.
4. Let the pupils generalize the final result themselves.

SUGGESTIONS FOR FURTHER STUDIES

It is very difficult for a researcher to touch all these aspects of a problem. So the suggestions for further studies may not be out of place here. They can be enumerated as follows:

1. The present study is confined to Roorkee city only. Similar studies can be conducted on the other cities and states also.
2. In the present a sample of 150 students have been taken up. Similar studies can be conducted with large groups.

3. In the present study only 3 schools have been selected. Similar studies can be conducted by taking more schools.
4. This study is confined to the students of Grade 8th only. Students from other grades could be selected.
5. The present study is confined to Government schools only. Similar studies can be conducted by taking private school also.

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