

**ERROR ANALYSIS OF GRADE X STUDENTS IN SOLVING  
MENSURATION PROBLEMS**

**A  
THESIS  
SUBMITTED**

**BY  
SALIKRAM GHIMIRE**

**IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE  
DEGREE OF MASTER OF EDUCATION**

**SUBMITTED  
TO  
DEPARTMENT OF MATHEMATICS EDUCATION  
CENTRAL DEPARTMENT OF EDUCATION  
UNIVERSITY CAMPUS  
TRIBHUVAN UNIVERSITY  
KIRTIPUR, KATHMANDU**

**2013**

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**2013**

## LETTER OF APPROVAL

Thesis Submitted By

Salikram Ghimire

Entitled

*Error Analysis of Grade X Students in Solving mensuration Problems* has been approved in partial fulfillment for the requirement for the degree of Master of Education.

**Committee for viva- voce**

**Signature**

Prof. Dr . Lekhnath Sharma  
(Chairman)

.....

Prof. Dr. Hari Prashad Upadhyay  
(Member)

.....

Mr. Abatar Subedi  
(Member)

.....

**Date:**

## LETTER OF CIRTIFICATE

This is to certify that Salikram Ghimire is a student of academic year 2065-2067 B.S. with thesis number 851, exam Roll No. 281228 (2066) campus Roll No. 074/064 and T.U. Regd. No. 9-2-382-31-2004 has completed this thesis under my supervision during the period prescribed by the rules and regulations of T.U. Nepal. The thesis entitled *Errors Analysis of Grade X Students in Solving mensuration Problems* is a study in Kavre District which embodies the result of his investigation conducted during the period 2013 at the Department of Mathematics Education, University Campus, Tribhuvan University, Kirtipur, Kathmandu. I recommend and forward this thesis to be submitted for the evaluation to award the degree of master of education.

.....  
(Prof. Dr. Hari Prasad Upadhyay)  
Supervisor

.....  
(Prof. Dr. Lekhnath Sharma)  
Head

Date:

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.....

(Salikram Ghimire)

## ABSTRACT

This study was carried out to answer the research questions what type of errors do students commit in solving problems of mensuration? And what are the causes of errors in solving problems? The design of research is mixed method using and Newman's criteria for error analysis as a theoretical basis of study.

All secondary schools students of Kavre district studying in academic year 2070 constituted population of study. One government school and one private school were selected randomly. One hundred students of these two schools were taken to constitute sample for written test. A mini-sample of 20 students was selected for interview.

Written test and interview schedule were used for the tools. Written test consists 10 questions of mensuration section from grade X textbook. Reliability of test was evaluated by piloting upon 40 students in New Rising School, Rayale of grade X and was found to be 0.91. Validity was constructed by critical judgment of supervisor.

The data collected from answer sheets were analyzed by comparing frequency of students (with percentages) under different errors and on the whole. Data obtained from interview were analyzed qualitatively by interpreting causes of errors made on answer sheets of written test.

Of all the students on the average one fifth made either process skill or transformation errors. One tenth students made reading errors. Comprehension errors were made because of lack of proper understanding of geometric terminologies and less skill to use formula of mensuration. Transformation errors were made because of insufficient knowledge of definitions and less skill to transform sentences into mathematical form. Students made careless errors because they want to work too quickly, they felt bored and fatigue. Students made many other errors because of their weak foundation.

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## ACRONYMS

C.E	=	Comprehension Error
C. D. C	=	Curriculum Development Centre
C <sub>a</sub> E	=	Careless Error
C <sub>o</sub> E	=	Correct answer
H.S.S.	=	Higher Secondary School
P E	=	Process Skill Error
R E	=	Reading Error
S. L.C.	=	School Leaving Certificate
T E	=	Transformation Error
M E	=	Motivational Error
IoE	=	Institute of Education
FoE	=	Faculty of Education

# Chapter I

## INTRODUCTION

### **Background of Study**

Like other aspect of human civilization, mathematics has its own origin. The origin of mathematics is based on human needs for survival. The more complex the society evolved, the more complex became the needs. The primitive tribe had little mathematical needs beyond counting but the complex society needed to solve complex logical problems that demanded mathematics to solve (Eves, 1983).

The history of mathematics tells that mathematics was originated along with the human civilization. The concept of number and the process of counting developed so long before the recorded history. It seems fair to argue that humans, even in most primitive times had some number sense, at least to the extent of recognizing more and less when some objects were added or taken from a small group. With gradual evolution of society simple counting became imperative. Gradually vocal sounds and written symbols were developed (Eves, 1983).

The term mathematics has been defined variously. According to the Oxford Advanced Learners Dictionary "Mathematics is the science of numbers and shapes and branches of mathematics include arithmetic, algebra, geometry and trigonometry"(Hornby, 2005, p. 946).

Mathematics Dictionary has defined mathematics as" the logical study of shape, arrangement, quantity and many related concepts. Mathematics often is divided into three fields' algebra, analysis and geometry"(James &James, 1986, p.239). The concise Oxford Dictionary of mathematics has defined mathematics as "the branch of human enquiry involving the study of numbers, quantities, data, shape and space and their relationship especially their

generalizations and abstractions and their application to situations in the real world. As a broad generalization pure mathematics is the study of the relationships between abstract quantities according to a well-defined set of rules and applied mathematics is the application and use of mathematics in the context of real world. Pure mathematics includes algebra, abstract algebra, calculus, geometry, number theory, topology and trigonometry. Applied mathematics includes mechanics, probability and statistics, quantum mechanics and relativity"(Clapham & Nicholson, 2009, p.287). In general mathematics is a branch of knowledge in the area of science which has its own undefined terms, definitions axioms, postulates and theorems and its structure consists of arithmetic, algebra, geometry and analysis.

The word 'mensuration is derived from Greek word mensuration, having meaning to measure and refers to that branch of mathematics which deals with measurement of geometric magnitudes such as area of surfaces and volumes of solids. It is a practical branch of mathematics.

Mensuration is divided into two parts, plane mensuration and solid mensuration:

- Plane mensuration deals with measurement of perimeter and area of plane figures like triangle, polygon, circles etc.
- Solid mensuration deals with measurement of surface area and volumes of solid objects like cube, cuboid, cone, cylinder etc.

Oxford dictionary of mathematics defines mensuration as 'measurement and calculation of lengths, angles, areas and volumes associated with geometric figures'. The dictionary by James and James defines mensuration as 'The measuring of geometric magnitudes, such as the length of lines, areas of surfaces , and volumes of solids.

Mensuration is main subject in lower secondary as well as in secondary level. In compulsory mathematics Mensuration has included covering 14% of weights in secondary level (CDC, 2064). The mathematics curriculum in elementary and secondary school faces serious dilemma when it comes to mensuration. The problem is not new and it has been taken into consideration from many decades. Many studies has been made to improve the poor situation in mensuration by indentifying factors affecting mensuration performance of secondary school students in mensuration. Among them Piaget study is considered. Piaget theory of cognitive development depends more on biological maturation as the child interacts with the environment according to piaget students who are in a relatively self-centered stage of mental development tends to accept the truth of a proposition if it appears to them to be true, students who are concrete thinkers may accept a general proposition only on the basis of few instances and students who are formal abstract thinkers are capable of logical deduction and of consciously operating within a mathematical system such as Euclidean system.

In Nepal, mensuration has been teaching from ancient time. Formal school was started with the opening of Darbar school in 1910 B.S. At the time contents of mensuration were not different to the contents offered in not different that the contents offered in British system of education in India. With the adevent of NESP (1971-1976) the mathematics curriculum of school was systematized. For the first time national level wise and subjective was objectives were spelled out. To fulfill all the objectives and goals of school, College of Education was restructured into the Institute of Education (IoE) which was responsible to train the pre-service as well as in-service teachers of all levels. In 1972 Faculty of Education (FoE) started Non-Euclidean geometry

teaching at Bachelor level so as to give pre-service and in service teacher a better understanding of Euclidean system at school (Upadhyaya, 2064).

In the context of Nepal the teaching and learning of Mensuration in secondary school has been facing many problems. Researcher has shown that most of the examinee in SLC examination attempts only few questions from Mensuration section. They made so many mistakes while solving problems from Mensuration section in comparison to arithmetic algebra and geometry. Some students solve questions and reach conclusion with incorrect process.

The researcher has been teaching mathematics to secondary level students in Kavre district since last four years. During this period what he has found is that the students studying in secondary level are very poor in mensuration. Most of the students left more questions from mensuration unsolved or partially solved in comparison to algebra, arithmetic and geometry. Although few of them tried to solve questions, they could not give satisfactory answer. This situation indicates that the performance of students is poor in mensuration.

There might be many reasons behind such poor performance of students in mensuration. One of the reasons might be that our students are examined mainly by using paper and pencil test and many students may not be able to pass over a number of successive hurdles when a student attempt to answer written test (Newman, 1977). This is why the researcher was interested to study errors committed by grade x students in mensuration.

### **Significance of Study**

Students who try to solve problems from mensuration can move away from what is normal or acceptable. That is they can make mistakes while solving problems from mensuration. Mistakes are of two types, mistakes at competence level and mistakes at performance level. Generally, mistakes at

competence level are known as errors. The term error may be defined as systematic deviation in students' performance while solving problem which occurs frequently in solving problems. Error analysis is the systematic study of the errors made by the learners. It is the stepwise procedure used to analyze the errors in the course of performance of learners. Most of secondary students seem to make errors when attempting to answer written mathematics word problem. According to Newman (1977) the errors occurs because a person has to pass over a number of successive hurdles while going through the solution. The hurdles occur in reading, comprehension, transformation, process skill and encoding. The main importance of this study lies on identifying and analyzing the errors committed by grade x students in solving problems of mensuration. The study has following significance.

- i. The study would help teachers and students to improve in their teaching learning strategies.
- ii. The study would help curriculum designers and educational planners to design curriculum and to make educational plan.
- iii. The study would help textbooks writers and concerned personnel in their work relating to it.
- iv. The study would help to researcher in the related field.

### **Statement of Problem**

The study was mainly focused on the analysis of errors committed by the grade x students in solving problems from mensuration. This study intends to answer the following questions:

- i. What type of errors do students commit in solving problems of mensuration?
- ii. What are the causes of errors in solving problems?

### **Objectives of the Study**

The main objective of this study were to analyze errors committed by the grade X students in solving problems from mensuration. Specially objectives of study were as follows:

- i. To identify and analyze different types of errors in solving problems of mensuration according to Newman analysis of errors.
- ii. To find the causes of errors in solving problems.

### **Delimitations of the Study**

- i. The study was limited in Kavre district.
- ii. The study was limited only in solving problems of mensuration of grade X.
- iii. Non-random sampling design was used.
- iv. Diagnostic test and interview were only tools for data collection.

### **Definition of Terms**

**Error:** Reading error, Comprehension error, Transformation error, Process skill error, Encoding error, Careless error.

**Error analysis:** Study of errors made by students in solving problems

**Mensuration problem:** Mensuration problem refers questions from mensuration section of grade X curriculum.

**Students:** Students refer to all subjects in the population.

**Paper-and-Pencil test:** A test consisting 10 items from mensuration section of grade X mathematics textbook which were used to diagnose errors made by students on solving problems from mensuration.

**Mistake :** Mistake is an error to choose badly or incorrectly.

## **Chapter II**

### **REVIEW OF RELATED LITERATURE**

For the research in any field, review of literature is necessary because it helps to eliminate the duplication of what has been done, provide helpful suggestions for significant investigation and broadens the knowledge of researcher in related area (Best and Kahn, 2009). The review has been divided into two parts: review of theoretical literature and review of empirical studies. Short reviews of such documents are presented below.

#### **Review of Theoretical Literature**

The review of theoretical literature has been made to provide theoretical basis of study. Theoretical basis of study play vital role in the field of research because it helps researcher to describe different concept considered in research and to prepare research design. Some of the related theoretical literatures are reviewed below.

#### **Newman's procedures for error analysis**

The Newman procedure is a method that analyzes error in problem solving. In process of problem solving, there are many factors that support the students to arrive at a correct answer. This method supposes that in the process of problem solving there are two kinds of obstacles that hinder student from arriving at correct answers.

Problems in linguistic fluency and conceptual understanding that corresponds with level of simple reading and understanding meaning of problems, and problems in mathematical processing that consists of transformation, process skills and encoding answers.

Newman(1977) conducted a research on "an analysis of sixth grade pupils errors on written mathematical tasks" and found that reading comprehension and transformation errors made by 124 low-achieving grade six pupils accounted for 13%, 22% and 12% respectively of all error made. Thus, almost half of errors made occurred before the application of process skills.

Newman(1977) mentioned that when a person attempts to answer a standard, written, mathematics word problem, then, that person should be able to pass over a number of successive hurdles: Reading (or decoding), comprehension, transformation, process skills and encoding. According to Newman a person wishing to obtain a correct solution to word problems must ultimately proceed according to following hierarchy.

Reading the problems, Comprehending what is read, Carryout mental transformation from the word of questions to the selection of an appropriate mathematical strategies, Applying the process skills demanded by the selected strategy and Encoding the answer in an acceptable written form.

Newman used the word 'hierarchy' because failure at any level of the above sequence would prevent problem solvers from progressing towards a satisfactory solutions(unless by chance they arrived at correct solution by faulty reasoning).

Newman (1983) recommended that following questions or requests be used in interviews which are carried out in order to classify students' errors on written mathematical tasks:

Please read the question to me (Reading). Tell me what the question is asking you to do (Comprehension). Tell me what method you can use to find an answer to the question(Transformation). Show me what to do to get the answer. Explain to me what you are

doing as you do it (Process Skills). Now write down your answer to the question (Encoding).

**Reading Errors (R)** : An error is classified as reading error if the student cannot read a key word or symbol in the written problem to the extent that this prevents him/her from proceeding further along an appropriate problem-solving path.

**Comprehension Error (C)** : An error is classified as comprehension error if the student is able to read all the words in the question, but does not grasp the overall meaning of the words and therefore unable to proceed further along an appropriate problem solving path.

**Transformation Error (T)** : An error is classified as transformation error if the student understand what the questions wanted him/her to find out but become unable to identify the operation, or sequence of operations, needed to solve the problem.

**Process Skill Error (P)** : An error is classified as process skill error if the student identifies an appropriate operation or sequence of operations, but does not know the procedures necessary to carry out these operations accurately.

**Encoding Error (E)** : An error is classified as encoding error if the student correctly works out the solution to problem, but could not express the answer in an acceptable written form.

**Careless Error (CA)** : An error is classified as careless error if when the child attempts the questions for the first time, he/she gets the incorrect answer and after the interviewer has listened to the Newman requests; the interviewer conceived that the child originally made a careless slip. This error may occur in any levels.

In Newman interview it is important that the interviewer does not help students over hurdles. If an incorrect response is given to the question, then

error is classified according to where first breakdown occurs in the attempt to get a solution. Usually, the interviewer is wise to go one step beyond the first hurdle the interviewee makes for any question. This is because sometimes the student knows how to do something but is unable to express that knowledge verbally in an interview. While working through word problems it is always possible for students to make careless error and there may be some students who deliberately give incorrect answer due to lack of motivation to answer to their level of ability. If pupils who originally get a question wrong get it right when asked by an interviewer to do it once again the interviewer should still make the five requests in order to obtain information whether the original error could be attributed to carelessness or motivational factor.

### **Review of Empirical Studies**

Review of empirical studies has been made to broaden knowledge in the related area and to eliminate the duplication of what has already been done. It also provides helpful suggestions for significant investigations .While writing the review of literature, three paragraphs out line should be followed. First paragraph should describe what is coming, second paragraph should describe all about it and third paragraph summarize what was reported (Best & Kahn, 2009).some of related empirical studies are reviewed below:

Marinas and Clement (1990) founded that over 90% of initial errors made by a sample of grade seven students from Penang in Malaysia were in the comprehensions or transformation categories, and less than 10% is the Process skills category.

Ellerton and Clements (1995) conducted a research by using Newman procedure. In their study 116 year 8 students in 12 classes in 5 schools in New South Wales and Victoria answered a set of written questions. Mathematics

teachers in two schools agreed that none of the questions should have been too difficult for their students. Half of the questions were in multiple choice form and other half of the questions in short answer form. In this study Newman interviews were conducted for all questions for all students in the sample including those questions for which correct responses has been given. When Newman interviews were conducted it was found that 80% of errors first occurred at the reading, comprehension and transformation stages, and only 6% of errors first occurred at the process skill errors.

Ellerton and Clements (1996) conducted a research by using Newman procedure. The study was a comparative investigation of errors made by 101 year 7 students in two junior secondary schools in Maleyu and 61 students in year 6 or year 7 in two primary schools in Perth ,Australia. The same paper-and- pencil test instrument was used with the Malaysian version being in Bahasa Malaysia and the Australian version in English. Every teacher of the pupil agreed that the questions were well worded and were not too difficult. Newman interviews were conducted by trained interviewers in the language of instruction for the children in Bahasa Malayu, Malaysia and English in Perth. Altogether, about 1480 errors were analyzed, 990 were made by the Malaysian children and 490 by the Australian children. The patterns of errors classifications in the two samples were strictly similar, with between 60% and 70% being in either in comprehension or in transformations categories and 10% (Malaysian) and 15% for Australian in the process skills category.

Bhatta (2003) conducted a research entitled "error analysis in quadratic equation at grade X". The objectives was to study the errors of grade X students in understanding knowledge, problem solving and application of quadratic equation with respect to gender and location of school. All grades X students of Kathmandu district were considered as population. The researcher

used diagnostic test and interview schedule for data collection. The data obtained were scored with the help of scoring key. T-test was used to compare the significant difference between sample mean. All differences were tested at 0.05 level of significance. The finding of study was that students committed more errors in knowledge and application of quadratic equation than in understanding and effect of location & gender is immaterial in committing errors.

Kafle (2006) conducted a research entitled "error analysis of the proof of the theorem in geometry in grade X". The objective was to identify errors and their causes. The research design was qualitative. Population of this research consists of all students of grade X of Shree Nagarjun Thuladhunga Secondary School, Jeetpurfedi, Kathmandu. The sample of 20 students was selected by purposive sampling method. The finding of the study was that one fourth of total errors were centered in reading and comprehension and highest percentage of errors were centered in the process skills.

Parkitipong & Nakamura(2006) conducted a research entitled" analysis of mathematics performance of grade five students in Thailand using Newman procedure". The main objective of study was revealing the causes of students' low achievement in mathematics at primary schools in Thailand. The research was conducted in two provinces that were Bangkok and Samutsakhhan provinces. Four public primary schools were chosen from each of the two provinces, two of them were from urban area and the other two were from rural area, to equally represent both provinces. They sum up eight schools as a sample. In each school, interview was carried out to five grade five students. Two of them were good performers and other three were poor performers. In total forty students were interviewed. The interview was conducted using five questions that were divided in to two groups: question 1 and 2 were multiple

choice questions and rests of three were structured questions. The questions attempted to cover major areas in grade four curriculums. Main findings of this study were as follows:

- Student's errors in multiple choice questions were mostly made at the stage of mathematical processing that comprises transformation, process skills, encoding level, while those in structured questions were made at the stage of comprehension level.
- Good performers tended to have stronger comprehension ability than poor performers. However, if we consider the mathematical processing stage, similar patterns were found regardless of different performers.

K.C. (2008) conducted a research entitled "analysis of error committed by students of grade IX in geometric transformation". His main objective was to identify the errors committed by students of grade IX in geometric transformation and compare the errors committed by girls and boys students. All the students of secondary level private schools of Kavre district were considered as the population of this study. Samples of 30 students were selected by non-random sampling technique. The finding of the study was that boys committed more errors than girls in all domains reading, comprehension, process skills and encoding.

Bhatt (2009) conducted research entitled "The error analysis on the problem solving of area of triangles and quadrilaterals". The objective of this study was to identify and analyze the errors committed by students in knowledge, skill, application and problem solving. The qualitative research design was used. Bhairawa Higher Secondary School of Dhading was selected to select respondents. By random sampling technique 50 students were selected from grade X. The finding of study was that the errors committed in

the comprehension, transformation, process skills, encoding and reading stage are in descending order.

Upadhaya (2007) Studied on "the type of error mostly done by the students of grade 'v' in "Janakpaur Municipality" He found that:

- Students were observed using their own method with confusion.
- Students did use their methods but could not supply enough reason while putting down in examination paper.
- Most of the students could not understand the situation given in language form.

Panthi (2009) studied on "an error analysis in equation of grade VIII" aim to

- Identify the error committed by students on problem solving.
- Analyze the error committed by student in problem solving.
- Compare the error with respect to gender.
- Student had committed more error in the area of knowledge then in the area of skill and application.

Sharma (2009) studied on "An error analysis in solving of grade five students" He concludes that 75% of error occurred at the comprehension, 12%, 5%, 8%, of error occurred on process skill, encoding and careless of studies respectively. And 40%, 34%, 26% error occurred on knowledge level, skill and application level and problem solving level respectively.

Chand (2008) Studied on "An error analysis of grade VI students in arithmetic. The main aim of this study was to identify the types of error committed by students of grade VI in solving verbal problems in arithmetic in Dhading district. The main findings of this studied are 6%, 34.9%, 14.8%, 3.7%, 2.8% and 5.1% errors are found in reading, comprehension, transformation, process skill, encoding, motivation and careless errors respectively.

Foulkner (1992) has used Newman techniques in research investigating the error made by the nurses undergoing a calculation audit. She found the majority of errors the nurses made were by comprehension of transformation type.

Bhattarai (2010) conducted research on “Errors made by secondary school students in trigonometry problem solving.” The objective of study was to identify and analysis errors committed by students on problem solving with respect to gender. The populations of this study were all the secondary students in grade X of Kapilvastu District. By purposive sampling technique 30 students were selected as sample. The finding of the study was that students commit errors in comprehension, transformation, process skills, encoding & reading stage are in descending order and there is no difference between the errors committed by boys and girls.

From the above information of the related literature lot of studies have been done in various issues. The error of school level mathematics on different classes and units have been studied. From there various conclusions has been achieved. But in grade X mensuration topic how the students made error and why the errors have made? is the main theme of analyzing datas because this topic hasn't been studied by others. So, I have analyzed in this topic.

## **Chapter III**

### **METHODS AND PROCEDURES**

#### **Research Design**

Research design is the conceptual structure within which research is conducted. It constitutes the blue print for the collection, arrangement and analysis of data. In this study researcher intended to describe what exist at present and to generalize it by determining nature and degree of existing conditions. Therefore, descriptive survey design was used for the study. Newman's procedure for error analysis were considered as theoretical basis of the study.

#### **Population**

Population is any group of individuals that has one or more characteristics in common that are of interest to the researcher (Best and Kahn, 2009). In descriptive research, population is that group of individuals to which results are generalized. This study is concerned with errors committed by grade x students in Kavre district. According to the educational statistics available in district education office Kavre there are 383 primary schools, 497 lower secondary schools and 208 secondary schools in Kavre. In secondary level 13682 students are studying in government schools and 3938 students studying in private schools during academic year 2070. Therefore, all grade x students of Kavre district in academic year 2070 constituted population for this study.

#### **Sample**

A sample is small representative proportion of population that is selected for observation and analysis (Best and Kahn 2009). Simple random sampling technique was chosen because it eliminates chances of biasness in

selecting of study samples. For this study one government school Shree Laxmi Narayan Higher Secondary School, Shyampati-2, Kavre and one private school Shree Lali Gurans Secondary School, Kushadevi-3, Kavre were selected randomly from the sample mentioned above.

As the sample of the study for written test one hundred students of grade X students were taken from two schools mentioned above. Out of one hundred 60 students from Laxmi Narayan H.S.S, 40 students from Lali Gurans Secondary School.

For the purpose of taking interview a small sample consisting 20 students 10 from each school were selected purposively so as to include each type of errors categorized by Newman. Among 20 students 10 from each school had taken for interview who had made more errors and the questions which had more errors in the research criteria.

## **Tools**

The information, facts, proofs etc. used in research are called data. Research tools are the instrument and techniques of collecting data for the study (Kumar 2009). The following tools were developed and used to collect data.

- Written Test
- Interview Schedule

## **Written Test**

This study concerns with errors committed in solving problems from mensuration. Therefore, students written answers to the questions from mensuration section were required. That is why; paper and pencil test was used for study. The test consisting ten subjective questions was constructed covering major areas of mensuration section in grade 10 curriculum of

mathematics. On the basis of content point and formulation of objectives, questions were taken following specification grid. The written test is given in Appendix I in English version and in appendix II in Nepali version.

### **Reliability of Test**

A test is reliable to the extent that it measures whatever it is measuring consistently. Reliable tests are stable in whatever they measure and yield comparable scores on repeated administration of test (Best and Kahn, 2009). To evaluate reliability of test, it was piloted to 40 students of class 10 of New Rising Secondary School, Rayale, Kavre. Coefficient of reliability was calculated through Spearman's split half method and found to be 0.91 Appendix V.

### **Validity of Test**

A test is said to be valid if it measures what is supposed to measure. If the questions in the test can reflect whole content then test can have content validity (Jabara, 2006). The content validity of this test was established by constructing the questions following content points, objectives and by consulting with supervisor.

### **Interview Schedule**

The interview is a face to face interpersonal role situation in which one person, the interviewer, asks to a person being interviewed, the respondent, question designed to obtain answers pertinent to the research problem (Khanal, 2006). Researcher intended to identify different type of errors categorized by Newman and interpret them, so, interview schedule based on Newman's procedure was used for the study. This schedule consist five requests to categorize error type and some other questions to interpret some errors .The interview schedule is given in Appendix III.

### **Administration of the Tools and Collection of the Data**

To collect data researcher visited schools selected in sample and concerned personnel were requested for co-operation and help to conduct field study. Researcher collected the score of mathematics of sample students of final exam of class 7, 8, and 9. With the help of mathematics teacher, paper-and-pencil test were administered in each of two schools. Answer copies were collected and checked to categorize different types of errors as categorized by Newman.

To select sample for interview all the students who were participated in the paper and pencil test were classified into three categories, good performers, poor performers and average performer students. For this classification marks in math obtained by each student in class 7,8 and 9 were also collected. For each class in each school first quartile ( $Q_1$ ) and third quartile ( $Q_3$ ) of set of marks in mathematics were calculated separately. Students who were below  $Q_1$  in a least two classes were considered as poor performers who were above  $Q_3$  in at least two classes were considered as good performers and remaining other were considered as average students.

Then, small sample of 20 students (10 from each schools) were selected purposively for interview so as to include each type of errors categorized by Newman as well as to include good performers, poor performers and average performers. Interview based on Newman's procedure was conducted. At the time of interview some errors were categorized, causes of errors and some particular responses were noted (vide Appendix VII).

### **Data Analysis Procedure**

Data collected from answer sheets were arranged in the form of tables as given in the Table1. Analysis was made under two separate headings. Firstly, analysis was made by comparing frequencies of students under

different errors on each of the ten questions and on the whole by using formula.

Data collected from interview were analyzed qualitatively by interpreting causes of different types of errors made on written test. For this written result was presented before the class and an interview was taken from them. Students knowledge, attitude and experience were collected in words as the same way the students presented. The collected data were analyzed in reasonable way and conclusion were presented.

## **Chapter IV**

### **ANALYSIS AND INTERPRETATION OF DATA**

This is a survey research related to analysis of errors of grade X students in solving problem of mensuration. The objectives of this study are to identify the errors in solving problems of mensuration and analyze them according to Newman criteria of the analysis of errors and to find the causes of errors. The sample of the study were 40 students of Shree Lali Gurans Secondary School Kushadevi-3 and 60 students of Shree Laxmi Narayan Higher Secondary School Shyampati-2. Written test and interview schedule were developed and used to collect the data as a tools. To evaluate reliability of test was piloted to 40 students of Shree New Rising Secondary School Rayale Kavre. Coefficient of reliability was calculated through Spearman's split half method and found to be 0.91. The validity of this test was established by constructing the questions, objectives of content and by consulting with supervisor. To evaluate reliability of the interview, the interviews were conducted repeatedly on 20 students included on pilot study. The validity of interview was ensured by critical judgment of supervisor. To collect data researcher visited schools selected in sample and concerned personnel were requested for co-operation and help to conduct field study. With the help of Mathematics teacher paper and pencil test were administered in each two schools. Answer copies were collected and checked to categorize different types of errors as categorized by Newman. Then small sample of 20 students (10 from each school) were selected for interview based on Newman procedure. Firstly analysis was made by comparing frequencies of students under different errors on each of the 10 questions and on the whole. Data collected from interview were analyzed qualitatively by interpreting causes of different types errors made on written test.

After the collection of data by using specified tools and techniques, the next step is analysis and interpretation of data so collected. In this study data were collected from answer sheet of written test and responses given in interview. In this study researcher aimed to identify different types of errors, compare patterns of errors committed students by interpret them in light of Newman's procedure of error analysis. The analysis was made under the following headings.

### **Analysis of Different Errors Committed by Students**

As mentioned in the method of study, a written test consisting 10 subjective questions was constructed (vide appendix III) and administered to 10 tenth grade students of Kavre district included in the sample so as to access different errors committed by students in written test. After evaluating students' written answers for the purpose of diagnosing errors, the errors were recorded on each question. Since the objective of the analysis was to diagnose different types of errors and the types of errors that were common to many students, the errors made by students were arranged in the form of table (table1) which consisted frequencies and percentage of students among errors on each question of test and on the whole.

**Table 1: Frequencies and Percentage of Students**

Q	R		C		T		P		E		C <sub>a</sub>		C <sub>o</sub>		Total	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	N	%
1	0	0	0	0	18	18	15	15	10	10	16	16	41	41	100	100
2	2	2	0	0	13	13	27	27	11	11	10	10	39	39	100	100
3	0	0	9	9	14	14	23	23	8	8	8	8	38	38	100	100
4	7	7	1	1	7	7	9	9	5	5	21	21	57	57	100	100
5	0	0	7	7	36	36	13	13	4	4	10	10	30	30	100	100
6	0	0	5	5	16	16	40	40	7	7	3	3	37	37	100	100
7	0	0	4	4	23	23	24	24	2	2	8	8	39	39	100	100
8	0	0	30	30	20	20	16	16	6	6	7	7	14	14	100	100
9	0	0	4	4	15	15	38	38	5	5	15	15	23	23	100	100
10	0	0	10	10	44	44	16	16	4	4	9	9	17	17	100	100
Total	9	0.9	70	7	206	20.6	221	22.1	62	6.2	107	10.7	325	32.5	675	100
Average	0.9		7		20.6		22.1		6.2		10.7		32.5		100	

*R=Reading error, C=Comprehension error, T=Transformation Error, P=Process Skills Error, E=Encoding Error, C<sub>o</sub>=Correct Answer, C<sub>a</sub>=careless Error, n=frequency of students and %=percentage of frequency of students.*

As shown in table1 above last row and the consisted of average number of students and percentages of students on each of reading, comprehension, transformation, process skill, encoding and careless errors. The figures on table show that 7% committed comprehension errors, 20.6% committed transformation errors, 22.1% committed process skill errors and only 6.2% committed encoding errors. The reading errors were found to be only 0.9%. These figures shows that about one fifth of all the students committed transformation or process skill errors, 32.5% made no errors and gave correct answers. Out of 1000 solutions 675 errors were made. Out of 100 students, about 32 students gave correct answers and the remaining made errors of one or another type with 68 students under transformation and process skill.

A look within the table shows that the greater number of errors under transformation and process skill have been partly due to greater number of errors on the questions 7,8, 9 and 10. Questions 7, 8, 9 and 10 demanded

students to develop skills. Such situation shows that the students might have felt comparatively difficult in developing skills and transformation. The interview taken to students reflected that the students felt difficulties in developing transformation skills.

To explain such information and diagnose students' difficulties in solving problems from mensuration, interviews were administered to 20 students selected purposively from sample of written test. Such analysis is made under separate headings.

The overall perception as to the distribution of errors in the respect of table1 has just been made. Some considerations of individual questions as well as in the respect of some errors is as follows

The highest percentages (44%) of students who committed transformation errors were found in question 10 among all the questions. Question Number 10 is about total surface area of pencil. The reason behind this might be that students were unable to determine transform given situation in mathematical form.

The highest percentage (40%) of students who committed process skill errors was found in question number six among all the questions. Question Number 6 is about volume of sphere. Such situation shows that students might have felt difficulty in the algebraic calculations such as transformations of numbers from left to right or right to left etc.

Reading errors were found only in questions 2 and 4. The interview taken to students reflected that the students felt difficulties to pronounce words "curved" of question 2, "hemisphere" of question 4.

The highest percentage (30%) of students who committed comprehension errors was found in question number 8 among all the questions. Question Number 8 is about volume of cylinder. Such situation

shows that students were unable to comprehend the meaning of the words symbols or figures.

The highest percentage (11%) of students who committed encoding errors was found in question number 2 among all the questions. Question Number 2 is about curved surface area of cone. The interview taken to students reflected that students have no habit to encode answer.

The highest percentage (21%) of students who committed careless error was found in question number 4 among all questions. Question Number 4 is about total surface area of hemisphere. Such situation shows that students might have difficulty to remember formula and difficulty in algebraic calculations.

From the above analysis it can be concluded that in the questions for which figures were given and need to apply formula to solve them, concentration of errors were at transformation level. The reason behind this might be that students felt difficult to select appropriate sequences of mathematical process to obtain correct solution because of insufficient knowledge of geometric facts. Also in the questions for which figures were not given and demanded to solve concentration of errors can be seen in process skill level. The reason behind this might be that students felt difficult to solve because of insufficient understanding of algebraic calculation.

### **Analysis of Errors Based on information From Interviews**

The interview schedule was developed and administered to a sample of 20 students selected from sample of 100 students participated in written test. The interview focused on diagnosing and interpreting different errors made by students in written test. The interview conducted to students was more focused on those questions and aspects of written test which yielded more

errors. The information from the interview was also focused to explain and interpret the errors depicted in table1.

Reading errors were made by only 0.9% students. The interview taken to students reflected that students made reading error because they were unable to read words 'hemisphere' , 'curved' included in the written test.

Some students who committed comprehension errors could not explain what information were given in question and what they had to find out and some students who committed comprehension errors couldn't explain meaning of terminologies like curved surface, hemisphere, perimeter, marble, cylindrical tank and solid object. So they were unable to understand overall meaning of problem and hence they committed comprehension errors.

In short answer type questions students committed transformation errors because some students were unable to recall related properties of geometric figures to solve problems and some were unable to apply them in correct place. This is why in short answer type questions many student committed transformation errors. Theoretical questions also students committed transformation errors because of insufficient knowledge of objects and less skill to use them in appropriate places so that students were unable to select sequence of mathematical operations.

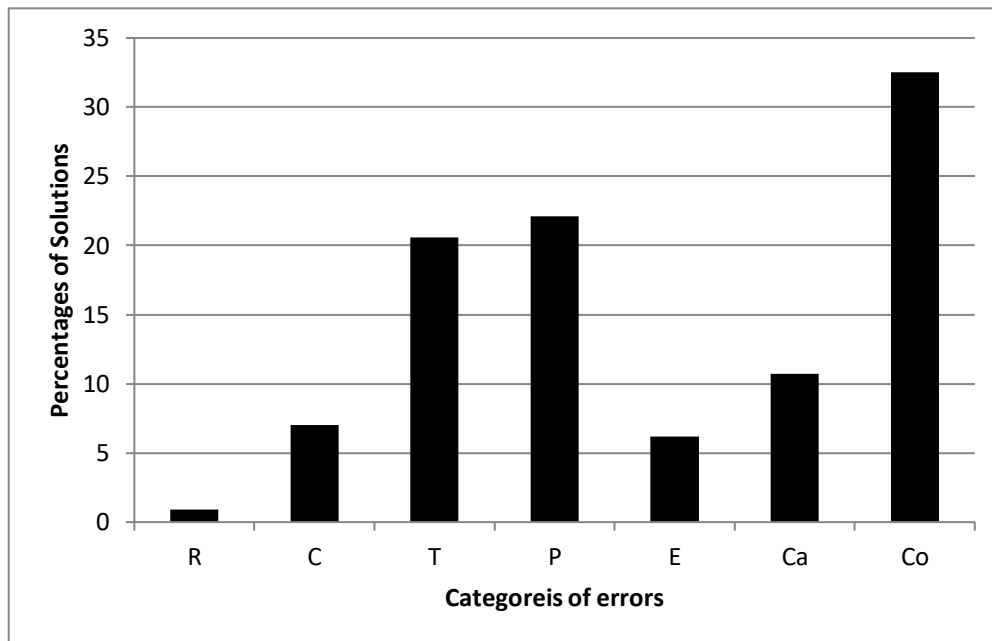
Because of insufficient knowledge of arithmetical and algebraic operations some students committed process skill errors. Students committed encoding errors because some students solved problems by memorizing process and couldn't explain answer appropriately.

In summary students committed reading errors because of some difficult words presented in question. They committed comprehension errors because of lack of proper understanding of geometric terminologies and words. They

committed transformation errors because of insufficient knowledge of geometric figures and less skill to apply them in proper places.

### Diagrammatic Representation of Errors

The distribution of errors has also been presented in diagrammatic form (diagram 1) as shown below.



**Diagram 1: Percentage of Frequency of Solutions in Different Categories**

*R=Reading error, C=Comprehension error, T=Transformation Error, P=Process Skills Error, E=Encoding Error, Co=Correct Answer, Ca=careless Error, n=frequency of students and %=percentage of frequency of students*

Above diagram shows that 0.9% students committed reading errors, 7% students committed comprehension errors, 20.6% students committed transformation errors, 22% students committed process skill errors, 6.2% students committed encoding errors and 10% students committed careless errors. The highest number of errors in process skill and the lowest number of errors in reading.

### Causes of errors

As mentioned in the method of study, a written test consisting 10 subjective questions was constructed (Appendix III) and administered to 10

tenth grade students of Kavre district included in the sample so as to access different errors committed by students in written test. After evaluating students' written answers for the purpose of diagnosing errors, the errors were recorded on each question. Since the objective of the analysis was to diagnose different types of errors and causes of errors that were common to many students. Data collected from answer sheets and responses of the interview were analyzed and found following causes of errors:

### **Reading errors**

An error is classified as reading error if the student cannot read a key word or symbol in the written problem to the extent that this prevents him/her from proceeding further along an appropriate problem-solving path.

Sample of Students Response

Interviewer: Read the question no. 3.

Interviewee: Find the total surface area of given .....

(Thus, student leaves the word hemisphere and committed reading errors)

Reading errors were found because students felt difficulties to pronounce the words curved , hemisphere etc.

### **Comprehension error**

An error is classified as comprehension error if the student is able to read all the words in the question, but does not grasp the overall meaning of the words and therefore unable to proceed further along an appropriate problem solving path.

One of the comprehension error committed by the student is illustrated below.

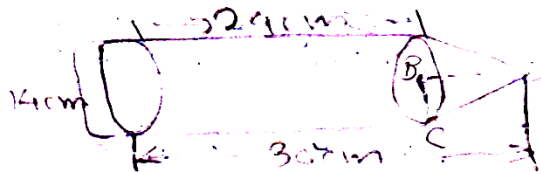
Q.No.10. Find the total surface area of given solid.

Sudeep Thapa had solved Q.No.10. in this following way.

10

Soln:

Radius (r) = 7 cm.



Height of cone (h) = 12 cm.

In rt angled  $\Delta ABC$ .

$$\begin{aligned} \text{slant height (l)} &= \sqrt{(7\text{cm})^2 + (12\text{cm})^2} \\ &= \sqrt{49\text{cm}^2 + 144\text{cm}^2} \\ &= \sqrt{193\text{cm}^2} \\ &= 13.89 \text{ cm.} \end{aligned}$$

Here,

$$\begin{aligned} \text{T.S.A of cone} &= \pi r l + \pi r^2 \\ &= \pi r (l + r) \\ &= \frac{22}{7} \times 7 (13.89 + 7) \\ &= 22 \times 20.89 \\ &= 459.58 \text{ cm}^2 \end{aligned}$$

[C. Error]

Again,  
 $\text{C.S.A of cylinder} = 2\pi r h$

Sample of Students Response

Interviewer: Read the question no . 10

Interviewee: (Read question correctly)

Interviewer: What is given?

Interviewee: Solid object

Interviewer: What you have to find?

Interviewee: Total surface area

Interviewer: What do you mean by total surface area of given object?

Interviewee: sum of total surface area of cylinder and cone.

(Thus student committed comprehension errors)

Comprehension errors were found because students were unable to comprehend the meaning of the words and figures. Students were unable to understand the information given in question.

### Transformation error

An error is classified as transformation error if the student understand what the questions wanted him/her to find out but become unable to identify the operation, or sequence of operations, needed to solve the problem.

One of the transformation error committed by the student is illustrated below.

Q.No.10. Find the total surface area of given solid.

Rojina Humagain solved Q.No.10. in this following way.

10 Sol<sup>n</sup>

Total surface area of given solid = ?

Height of solid =  $36\text{cm} - 24\text{cm}$   
 $= 12\text{cm}$

Radius of solid =  $14\text{cm}$

Then

Total surface area of given solid =  ~~$2\pi r(h+r)$~~

$T = \text{Error} = 2 \times \frac{22}{7} \times 14 \times 12$

$\times (14 + 12)$

$= 44 \times 2(14 + 12)$

$= 2288\text{cm}^2$

$\therefore$  Total surface of given solid is  $2288\text{cm}^2$

Sample of Students Response

Interviewer: Read the question no. 10

Interviewee: (Read correctly)

Interviewer: What is given?

Interviewee: Diameter of base, length of cylinder and total length of given solid object.

Interviewer: What you have to find out?

Interviewee: Total surface area of given solid.

Interviewer: How you planned to answer this question?

Interviewee: Sir, I didn't solve it because I wouldn't have any idea.

(Thus student couldn't selected appropriate process to carryout solution and made transformation errors)

Transformation errors were found because students were unable to select appropriate process to carryout solution. They can't transform sentences into mathematical form. Also students were unable to recall and relate properties of geometric figures.

### **Process skill error**

An error is classified as process skill error if the student identifies an appropriate operation or sequence of operations, but does not know the procedures necessary to carry out these operations accurately.

One of the process skill error committed by the student is illustrated below.

Q.No.7. The volume of the cylindrical tank is  $936\text{m}^3$ . If its height is 6m, find the base area of tank.

Sabin K.C. had solved Q.No.7. in this following way.

7. The value of a cylinder tank =  $3936 \text{ m}^3$   
 height =  $6 \text{ cm}$   
 value of cylinder =  $396 \text{ m}^3$  → Area of base  
 height of tank =  $6 \text{ cm}$  → Area of base  
 The base of tank = ? The cylinder is  $15 \text{ cm}^2$   
 $\therefore$  Area of cylinder = Area of base  $\times$  height  
 or,  $\frac{396 \text{ m}^3}{6} = \text{Area of base}$

(Error)

### Sample of Students Response

Interviewer: Read question no. 7

Interviewee: Read correctly

Interviewer: What you have to find?

Interviewee: Base area of tank.

Interviewer: How you planned to find?

Interviewee: First, I used formula then i solved

Interviewer: Solve as you told me.

Interviewee: Used formula then  $396 = \text{base area} \times 6$

$$\text{or } \frac{396}{6} = \text{base area}$$

$$\text{base area} = 15 \text{ cm}^2$$

(Thus student makes process skill error)

Students made process skill error because they felt difficulty in sufficient understanding of algebraic and arithmetic calculations. Many errors were made because of weak foundation of student.

### Encoding error

An error is classified as encoding error if the student correctly works out the solution to problem, but could not express the answer in an acceptable written form.

One of the encoding error committed by the student is illustrated below.

Q.No.9. Find the volume of given solid.

Jiwan Sapkota had solved Q.No.9 in this following way.

∴ radius of the sphere is 8.38cm

Q. 9. Soln,

$$\begin{aligned}\text{volume of cuboid} &= \text{length} \times \text{breadth} \times \text{height} \\ &= 6\text{cm} \times 6\text{cm} \times 5\text{cm} \\ &= 36\text{cm}^2 \times 5\text{cm} \\ &= 180\text{cm}^3\end{aligned}$$

~~Volume of prism = Area of base~~  
volume of prism =  $\frac{1}{3} \times \text{Area of base} \times \text{height}$

$$\begin{aligned}&= \frac{1}{3} \times 36\text{cm}^2 \times (15 - 5\text{cm}) \\ &= \frac{1}{3} \times 36 \times 10 \\ &= 120\text{cm}^3\end{aligned}$$

Now,

$$\begin{aligned}\text{volume of the solid} &= \text{Area of cuboid} \\ &\quad + \text{area of prism} \\ &= 180\text{cm}^3 + 120\text{cm}^3 \\ &= 300\text{cm}^3 \text{ Ans.}\end{aligned}$$

[E-Error]

Sample of Students Response

Interviewer: How do you planed to answer question number 9?

Interviewee: By using formula of volume of cuboid and prism.

Interviewer: Find the volume of given solid object?

Interviewee: Student used formula and found out volume of solid

$$= 300\text{cm}^3$$

Interviewer: (By showing his copy) Why you didn't write volume of solid object equal to 300cm<sup>3</sup> at last?

Interviewee: Sir sorry.

(Thus students makes encoding error)

Students made encoding error because they solved problems by memorizing process and couldn't explain answer appropriately. Also they didn't habit to encode answer. Some students forgot to encode the answer.

### Careless error

An error is classified as careless error if when the child attempts the questions for the first time, he/she gets the incorrect answer and after the interviewer has listened to the Newman requests; the interviewer conceived that the child originally made a careless slip. This error may occur in any levels.

One of the careless error committed by the student is illustrated below.

Q.No.4. Find the total surface area of given hemisphere.

Sunita Ghimire had solved Q.No.4. in this following way.

Q. Find the total surface area of given hemisphere.  
Sol<sup>n</sup>  
Given  
Radius = 14 cm  
Total surface area of given hemisphere =  $3\pi r^2$  *error*  
Now  
Total surface area of hemisphere =  $4\pi r^2$   
 $= 4 \times \frac{22}{7} \times (14)^2$   
 $= \frac{17248}{7}$   
 $= 2464 \text{ cm}^2$

### Sample of Students Response

Interviewer: How you planned to answer question no. 6

Interviewee: By using formula.

Interviewer: Find the area of hemisphere.

Interviewee: Student used formula  $2\pi r^2$

Interviewer: (By showing his copy) why you wrote  $4\pi r^2$ ?

Interviewee: Sir, mistake.

(Thus student makes careless error)

Students made careless errors because they were unable to remember formula and felt difficulty in algebraic and arithmetic calculations. Also students want to work too quickly and feel bored and fatigue.

## **Chapter V**

### **SUMMARY, FINDINGS, CONCLUSION AND RECOMMENDATION**

After completion of analysis and interpretation of data in chapter IV, this chapter is devoted to summary, findings, conclusions and recommendations of the study. It begins from summary of the study followed by findings, conclusions and recommendations.

#### **Summary**

The first section of this chapter is summary which summarizes the importance of the study, objectives of study, procedures and methods adopted in the study. This research was conducted to analyze errors committed by secondary school students in solving problems in mensuration. The study was mainly focused on identifying and analyzing the errors made by grade X students in solving verbal problems in mensuration. The study was done to attain the following objectives

- To identify and analyze different types of errors in solving problems from mensuration on the basis of Newman error analysis procedure.
- To identify the causes of errors.

The descriptive survey design was adopted for this study. Newman's error analysis procedure was considered as theoretical base of study. Written test and interview schedules were constructed as research tools. Written test consists of 10 questions from mensuration section of grade X text book prescribed by CDC. To test reliability of written test, 40 students of grade X of New Rising Secondary School were piloted and the reliability coefficient was found to be 0.91. Validity of test was established by selecting questions following content points and by judgment of supervisor. One interview schedule was developed viz. interview schedule.

The population of study consists of all secondary school students of Kavre district studying in the academic year 2070. Two schools (one private and one government) were selected by purposive sampling method. One hundred students of grade X of these two schools constituted sample for written test and only 20 students were selected purposively for the interviews out of the 100 students. Data collected from answer sheets and responses for the interview were analyzed under the following headings.

- a. Analysis of different errors committed by students.
- b. Analysis of errors from view point of Newman procedure.

### **Findings**

The research was conducted to analyze errors committed by secondary school students in solving problems of mensuration using Newman's theory of error analysis. Students' problems in mensuration were also assessed to explain students thinking in addition to Newman's error analysis. Therefore the findings based on analysis have been made

- The students committed 9 (0.9%), 70 (7%), 206 (20.6%), 221 (22.1%), 62 (6.2%) and 107 (10.7%) errors in reading, comprehension, transformation, process, encoding and careless respectively.
- They committed highest number of errors in process skill and the lowest number of errors in reading. Therefore process skill found to be most problematic for the students.
- The students committed 206 (20.6%) errors in transformation. This shows that students cannot transform sentences into mathematical form.
- Only few students were distributed in other types of errors. In short answer type subjective questions maximum students committed transformation errors and few students committed encoding errors.

- The result from interview indicated that reading errors were made because of some relatively difficult words and symbols. Comprehension errors were made because of lack of proper understanding of terminologies and words. Students committed transformation errors because of insufficient knowledge facts and formula. And less skill to apply them in proper places. Students committed process skill errors because of insufficient knowledge appropriate operation accurately. Students committed encoding errors because they can performed the correct operation but did not write the correct answer.

## **Conclusion**

The research was conducted to analyze errors committed by grade x students in solving problems from mensuration based on Newman error analysis. On the basis of findings of study following conclusion were made

- Of all the students on the average one fifth students made either process skill or transformation error. Process skill errors were made highly in questions having joined figure. Comprehension errors were made because of lack of proper understanding of geometric terminologies and words. Transformation errors were made because they were unable to transform sentences into mathematical forms.
- One tenth of students made errors in reading because they did not recognize key words or terminologies.
- Students made errors in process skill because they made errors in arithmetic and algebraic operation.
- Students made errors in encoding because they performed the correct operations but did not write the correct answer.

- Students made careless errors because they want to work too quickly, they felt bored and fatigue.
- Students made other many errors because of weak foundation.

### **Recommendation**

Research report concludes with recommendation given for educational implication and for further research work. By analyzing and interpreting the data, some useful facts were obtained by researcher. Two subtopics under this section are described below.

### **Recommendations for the Educational Implication**

On the basis of findings and conclusions of the research work following recommendations for educational implications can be made

- Since maximum errors were committed in process skills and transformation level, so while conducting teaching learning activities emphasis should be given in understanding of the problems and selecting appropriated mathematical operations to solve problem on calculation part.
- Since students which belongs in lower level than they need to have to solve given problems, can't solve the problems, therefore, in any domain of mensuration teacher should find out students level of thought and should give sufficient experiences of each level which they must possess before solving problems. Without having sufficient knowledge of lower to secondary levels teacher should not provide materials of higher level.
- Sufficient example should be provided to the students while teaching.
- Special attention should be paid to students while teaching.
- More practice exercises on each of the problematic areas should be provided.

- The students should be encouraged to practice and write.
- The teacher should re teach the areas where students committed the more errors. This leads to continuous reduction of the number of errors they commit in each of the areas.
- Textbook should be well ordered to meet hierarchical order. Materials of higher levels should be presented only after presentation of the sufficient materials needed to master lower levels.
- Curriculum should be so arranged that students can get sufficient experience in each level of thinking in mensuration.

### **Recommendations for Further Study**

Since the study was limited in the Kavre district, the finding of this study can not be generalized to all subjects and areas all over the country. Considering this limitation the following recommendation have been made for the further study to obtain and valid generalization of the result of the study.

- i. Research can be replicated with wider coverage of sample of students
- ii. Study of this kind can be conducted at lower secondary as well as primary levels.
- iii. Since this study mainly limited on determining different types of errors and analyzing them from viewpoints of Newman error analysis so other studies can be conducted by using Newman error analysis.
- iv. Study can be conducted by using clinical interviews together with the tests.
- v. The studies could be done in other topic in same subject.
- vi. Similar types of studies should be done in different district and compare each result.

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# APPENDICES

## Appendix I

### Written Test (English Version)

#### WRITTEN TEST

#### Written Test

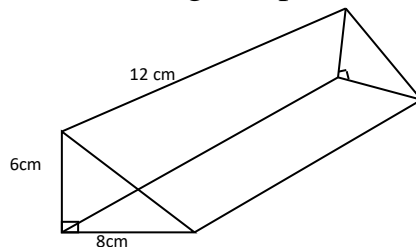
Time: 1 Hour 15 Min

F.M.: 26

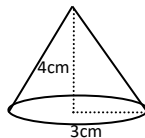
*This test is being held to improve student's performance in mensuration by analyzing errors. Therefore, all the students are requested to give answer in their own words as far as possible. This is because researcher can find actual weaknesses and strengths of students and can give appropriate suggestions to improve their performance in mensuration.*

**Attempt all the questions**

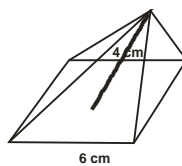
1. Find the volume of given prism. 2



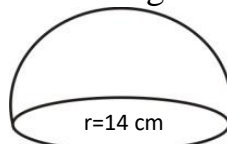
2. Find the curved surface area of given cone. 2



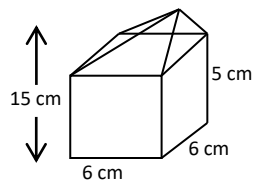
3. Find the total surface area of given square based pyramid. 4



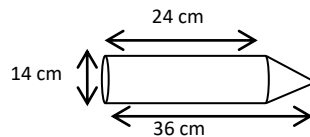
4. Find the total surface area of given hemisphere. 2



5. The ratios of three sides of a triangle is 3:4:5 and perimeter is 12cm then find the area of the triangle. 2
6. The volume of a marble is  $\pi/6\text{cm}^3$ . Find its diameter. 2
7. The volume of a cylindrical tank is  $936\text{m}^3$  . if its height is 6m, find the base area of tank. 2
8. If a metallic cylinder having volume  $2464\text{cm}^3$  melted into a sphere then find the radius of sphere. 2
9. Find the volume of given solid. 4



10. Find the total surface area of given solid. 4



"THE END"

**Appendix II**  
**Written Test (Nepali Version)**

**WRITTEN TEST**

Time: 1 Hour 15 Min

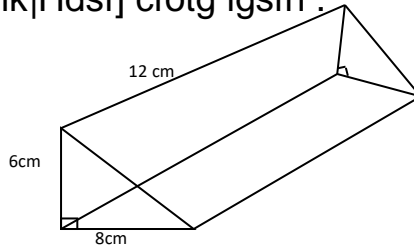
F.M.: 26

*This test is being held to improve student's performance in mensuration by analyzing errors. Therefore, all the students are requested to give answer in their own words as far as possible. This is because researcher can find actual weaknesses and strengths of students and can give appropriate suggestions to improve their performance in mensuration.*

**;) k|Zgx? xn u/ .**

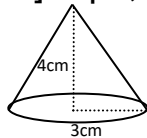
1. lbOPsf] lk|Hdsf] cfotg lgsfn .

@



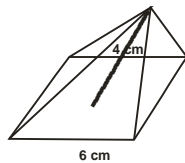
2. lbOPsf] ;f]nLsf] aqm;txsf] lf]qkmn lgsfn .

@



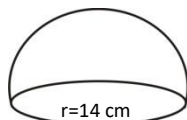
3. lbOPsf] juf{sf/ lk/fld8sf] k'/f ;txsf] lf]qkmn lgsfn .

\$

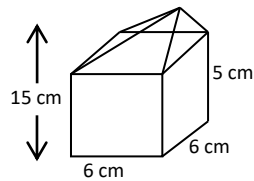


4. lbOPsf] cw{uf]nfsf/ 7f]; j:t'sf k'/f ;txsf] lf]qkmn lgsfn .

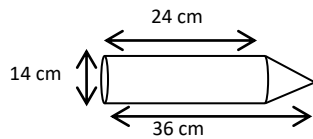
@



5. Pp6f lqe'hsf ltgj6f e'hfx?sf] cg'kft 3:4:5 / kl/ldlt 12cm 5 eg] ;f] lqe'hsf] lf]qkmn kQfnufp . @
6. Pp6f u'Rrfsf] cfotg  $\pi \div 6\text{cm}^3$  5 eg] o;sf] Jof; lgsfn . @
7. Pp6f a]ngfsf/ 6\oflssf] cfotg  $936\text{m}^3$  5. o;sf] prfO{ 6m eP ;f]6\ofls+sf] cfwf/sf] lf]qkmn lgsfn .
8. olb  $2464\text{cm}^3$  cfotg ePsf] wft'sf] a]ngfnfO{ kufn]/ uf]nf agfOof] eg] uf]nsf] cw{Jof; lgsfn . @
9. lbOPsf] 7f]; j:t'sf] cfotg lgsfn . \$



10. lbOPsf] 7f]; j:t'sf] k'/f ;txsf] lf]qkmn lgsfn . \$



"THE END"

## **APPENDIX III**

### **INTERVIEW SCHEDULE (on Newman's Procedures)**

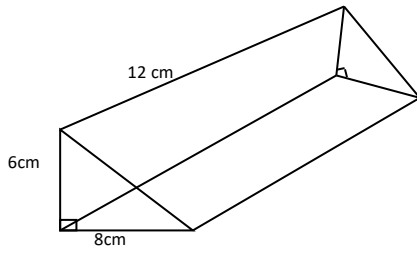
To find causes of errors interviewer is wise to ask some other questions related to each of twelve subjective questions depending upon the responses.

- Please, read the question.
- Tell me what is given and what you have to find out. Also explain....  
(corresponding terminology included in the question)
- Tell me how you planned to find answer. Describe each step you had included in your strategy.
- Tell me and show me what you did to get the answer.
- What was your answer point out and explain.

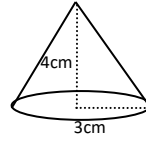
## Appendix IV

### Diagrams

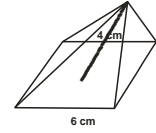
i.



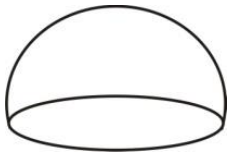
ii.



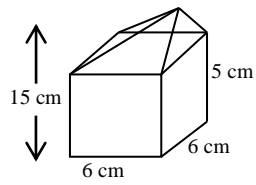
iii.



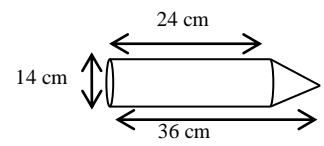
iv.



v.



vi.



## Appendix V

### Calculation of Reliability Coefficients

Calculation of reliability coefficient of written test

Let X: Marks obtained in odd questions.

Y: Marks obtained in even questions.

X	Y	X <sup>2</sup>	Y <sup>2</sup>	XY
39	41	1521	1681	1599
44	321	1936	1024	1408
41	52	1681	2704	2132
33	25	1089	625	825
16	8	256	64	128
$\Sigma X = 173$	$\Sigma Y = 158$	$\Sigma X^2 = 6483$	$\Sigma Y^2 = 6098$	$\Sigma XY = 6092$

Here,

$$\Sigma x = 173, \Sigma Y = 158, \Sigma X^2 = 6483, \Sigma Y^2 = 6098, \Sigma XY = 6092, N=5$$

$$\begin{aligned} \text{Correlation coefficient}(r) &= \frac{N \Sigma XY - \Sigma X \Sigma Y}{\sqrt{N \Sigma X^2 - (\Sigma X)^2} \sqrt{N \Sigma Y^2 - (\Sigma Y)^2}} \\ &= \frac{5 \times 6092 - 173 \times 158}{\sqrt{5 \times 6483 - (173)^2} \sqrt{5 \times 6098 - (158)^2}} \\ &= 0.84 \end{aligned}$$

$$\text{Therefore, coefficient of reliability} = \frac{2r}{r+1} = \frac{2 \times 0.84}{0.84+1} = 0.91$$

## **APPENDIX III**

### **INTERVIEW SCHEDULE (on Newman's Procedures)**

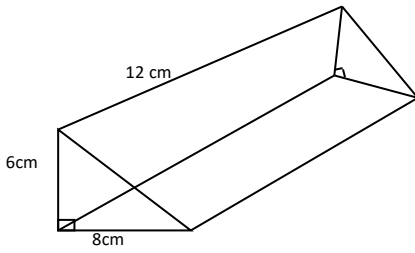
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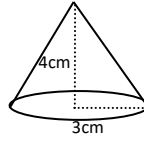
# Appendix IV

## Diagrams

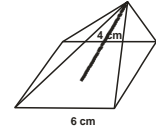
i.



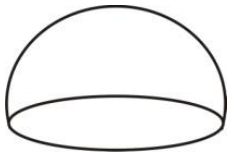
ii.



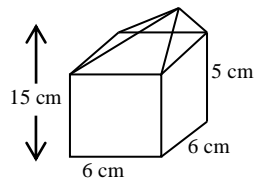
iii.



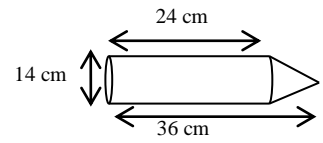
iv.



v.



vi.



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## **APPENDIX III**

### **INTERVIEW SCHEDULE (on Newman's Procedures)**

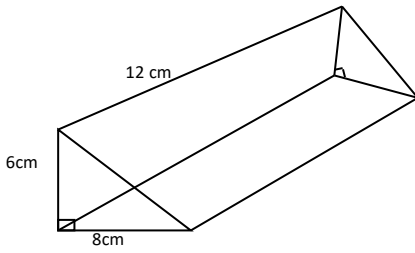
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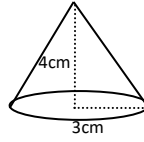
# Appendix IV

## Diagrams

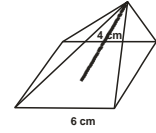
i.



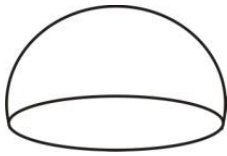
ii.



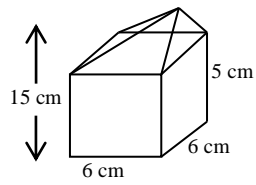
iii.



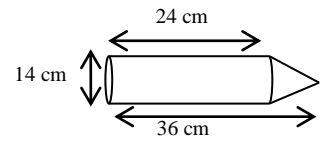
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