AN ERROR ANALYSIS IN SOLVING VERBAL PROBLEMS ON CO-ORDINATE GEOMETRY

A

THESIS

BY

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LETTER OF CERTIFICATE

This is to certify that Mr. Bimalesh Kumar Jha a student of academic year 066/68 with exam roll no. 281202, campus roll no. 1255and T.U. Registration no. 9-2-50-1722-2005 has completed this thesis under my supervision during the period prescribed by the rule and regulation of Tribhuvan University. The thesis entitled **An Error Analysis in Solving Verbal Problem on Co-ordinate Geometry** embodies the result of his investigation conducted during the period of at the Department of Mathematics Education, University Campus, Tribhuvan University, Kirtipur, Kathmandu. I recommend and forward that this thesis be submitted for the evaluation for awarding the degree of Master of Education.

…….. ……

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LETTER OF APPROVAL

A

Thesis

By

Bimalesh Kumar Jha

The thesis entitled "**An Error Analysis in Solving Verbal Problem on Co-ordinate Geometry"** has been approved for the partial fulfillment of the Requirements for the degree of Master of Education.

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Date:- ……

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Date: Bimalesh Kumar Jha

ABSTRACT

Without making any errors none of learners can learn. Some commit more errors while some commit less. In the process of learning mathematics, students make many errors as it is one of the most difficult subjects. Most of the students feel mathematics a difficult subject which is reflected by their final score in SLC. Errors made by students should be identified by the teacher to minimize it as possible. It is their duty.

Here, the present study was concerned with error analysis. This study was carried out in grade X of four schools in Dhanusha district. The study of error had been done in co-ordinate geometry of grade ten optional mathematics. The purposes of the study were to identify the errors committed by the students of grade X of Dhanusha district in co-ordinate geometry and to find the causes of errors committed by the students. One hundred twenty students were taken as a sample from four schools. Among them, sixty were girls and sixty were boys. Two types of data collection tools were used for this study. The first one was achievement test (problem solving) and second was interview schedule. Furthermore, the interview schedule was categorized into two i.e. interview schedule for the sample students and interview schedule with related mathematics teachers. Different types of questions were included in the problem solving test. The error found in problem solving test were analyzed on the basis of Newman technique of error analysis. Those errors were collected by checking answer sheet and by taking interview with the students because it was impossible to find reading and comprehension error without interview. The second purpose of the study was to find out the causes of error in solving verbal problems on co-ordinate geometry for this interview was conducted on mini- sample of twenty students, which were selected from one

hundred twenty sample students. And another interview was conducted to the sample teachers.

It was concluded that the students commit errors from the beginning (reading level) to the deduction of result (encoding level). The concentration of errors was seen on the process level.

The students have difficulty with reading because they found it hard to establish a context for a particular text to predict the meaning of the text and anticipate words that are likely to occur within it. The students who have difficulty with comprehension are due to monotonous environment of the classroom, due to lack of knowledge of technical terms in mathematics. The students who have difficulty with transformation are due to lack of discussion in classroom. The students who have difficulty with process are due to mix up rules because they do not really have rational understanding of what are they doing. Encoding errors are due to lack of regular practice of mathematical problems.

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Chapter I

INTRODUCTION

Chapter overview

This chapter consists of the background of the study, statement of the problem and objective of the study. It also explains significance of the study, delimitation of the study and definition of the key term.

Background of the Study

Mathematics is the science of measurement, quantity and magnitude. According to oxford dictionary mathematics is "The abstract science of number, quantity and space, either as abstract concepts (pure mathematics), or an applied to other disciplines such as physics and engineering (applied mathematics)". The term mathematics has been explained in various ways such as: it is the numerical and a calculation part of man's life and knowledge. Mathematics is the science of number and their operation, interrelation and collection of skill and methods. At the primitive times mathematics was originated for counting by the use of stones and tying knots in a string. Ancient people developed the mathematics structure, rules, formulas, theories etc. (Sidhu, 1975). It has also been defined as the science of number and the science of calculation. It is a systematized, organized and exact branch of science.

Mathematics provides a set of tools for describing analyzing and predicting the behaviors of system of many kinds conversing different aspect of the world. It is useful in accounting, surveying, engineering and the physical sciences to biology, economics and business and many aspects of everyday life. Now a day's one cannot do anything without use of fundamental process of mathematics in daily life. Being a subject of wide application

mathematics learning has been a must for every human being. In the course of learning mathematics people do errors and mistakes. Few errors are there, more learning can be assured.

Error vs. Mistake

This research study is related to error analysis in solving verbal problems on co-ordinate geometry. One can be confused between two words error and mistake because normally they seem to be same and often used as synonyms in daily life.

According to Wikipedia an error is a deviation from accuracy or correctness. A mistake is an error caused by a fault: the fault being misjudgment, carelessness or forgetfulness. (wikipedia.org/wiki/error, 15 July 2014)

All learners make mistake. We often make mistake when we solve problems. Errors and mistakes are synonymously taken in layman's sense. Technically speaking all mistakes are not errors. Errors occur as the result of lack of competence where as mistakes occur due to psychological or physiological reason or by carelessness. Mistake may be occurred either at competence level or at performance level. Mistakes that are committed at competence level are called errors and mistakes that are committed at performance level are called mistakes or lapses. Errors occur because of lack of competence and they tend to occur time and again. So they are said to be systematic.

The mistake tends to occur due to carelessness. As such it does not appear repeatedly can be correlated by the performer himself. The term "error" can be defined as a systematic deviation from the norm of the code or a breach of the code due to inadequate knowledge of the code. Even if the learner's attention is drawn to the errors he/she cannot make correction rather there may be chance of committing of other errors. Coder (1973) points out the need to

distinguish “error” (i.e. deviant sentence which are the result of lack of competence) from mistakes or lapses (i.e. deviant sentences which are result of psychological or physiological reasons).

From the above definitions it can be summarized that error is that mistake which occur time and again in a systematic way. So it is better to take into consideration only those deviant as errors which occur regularly in the form of learner’s performance.

The study of learner's error occurrence in solving word problem has a great importance in mathematics teaching and learning. Error analysis refers to the systematic study and analysis of error made by the learners. It is stepwise procedure to analyze the errors in the course of performance of learners. Error analysis is significant in three different ways. Firstly to the teachers to find out how far towards the goal the learner has progressed and consequently what remains for him to learn. Secondly, error analysis provides evidences to the researcher and course designers to know how mathematics is learnt, what strategies or procedures the learner is employing in his discovery of the mathematical knowledge. Thirdly, error analysis is indispensable to the learners themselves because we can regard the committing of errors as device to the learner which is used in order to correct their mistakes and learn efficiently.

We can find various studies on the analysis of errors on various mathematics strums in Nepalese context. However, the specific study on the error analysis of co-ordinate geometry is unstaunched till data. In this scherzo, the researcher considered appropriate to make a study on the pattern on committing errors on co-ordinate geometry and the reasons behind it.

Statement of the Problem

Any research study aims to solve some specific questions. In this study analysis of errors in solving verbal problems on co-ordinate geometry was aimed. It is widely accepted fact that students are not doing well in mathematics subject. However, finding out the reasons is not the easy task. For specific treatment of the practical problems facing by the students overall mathematics subject must be divided into the identifiable small portions and efforts must be applied to those portions specifically. So, the researcher had taken initiation on the chapter of "Co-ordinate Geometry" of Grade XI optional mathematics subject and tried to find out the places where the students make mistakes within the various stages of solving the problems. Only upon finding the places of mistakes one can provide the solutions and expect higher achievement level in the subject matter.

Most of the problems in mathematics are asked in the forms of verbal problem. Errors occurred frequently in solving the verbal problems. Word problem abound both on mathematics tests and in everyday life. A word problem tells a story, it may also present a situation in terms of constant or variable or both. The study also aimed to find out the causes of errors in solving verbal problems on co-ordinate geometry. Especially this study aimed to answer the following research questions:

1. What is the frequency of error the students commit while solving verbal problems on co-ordinate geometry?
2. What sort of error do students commit in solving verbal problems on co-ordinate geometry?
3. What are the causes of error on solving verbal problem of co-ordinate geometry?

Objectives of the Study

The main objectives of this study were the following:

1. To find the errors made by students of grade X in solving verbal problems on co-ordinate geometry.
2. To find the causes of errors in solving verbal problems in co-ordinate geometry.

Significance of the Study

Most of the students feel mathematics as a different subject which is reflected by the final scores in SLC. Errors made by students should be identified by the teacher to minimize it as much as possible. The design, development and implementation of improved teaching strategies is possible only after knowing the frequently of different types of errors committing by the students and reasons for the same. The co-ordinate geometry is a useful topic from where no one can escape. However, to improve learning of co-ordinate geometry it is very important to find out what errors are committed by the learners? Why they make errors? And what are the ways to make it simple while teaching? Remembering these facts as central point the research would study on “A study of errors analysis committed by student of grade ten in solving verbal problems on co-ordinate geometry”.

Significance of this study:

1. It would provide the students to acquire the power of acquiring knowledge.
2. This study is supposed to be significant for the students as this study sought to find out the general pattern of error in solving verbal problems in co-ordinate geometry. It would help them correct those areas where errors occur mostly.
3. It would help teacher to organize his experience in an appropriate teaching plan.

4. This study would significant for researcher and curriculum designer as this study report would open the door for further research in this field.

Delimitation of the Study

The study has the following delimitations:

1. The study was limited in Dhanusha district.
2. The samples of the schools were taken in accordance to the convenience of the researcher, so the results could not be generalized to all other context.
3. Some of the variables, like age level of students, classroom environment, rank, of the students and socio-economic status of the sample students were ignored.
4. The study was limited to the topic of co-ordinate geometry in optional mathematics of grade ten.

Definition of the Related Terms

Error: Error refers to the mistake which occur regularly in the form of learner's performance.

Error analysis: Error analysis refers to the systematic study and analysis of errors committed by the students.

Verbal Error: The errors found in the solution of verbal problem of co-ordinate geometry are defined as verbal error.

Reading Error: If the student cannot read the key words or symbols of given verbal problem, this type of error is classified as reading error.

Comprehension Error: If the students cannot grasp the overall meaning of the given problem this type of error is classified as comprehension error.

Transformation Error: If the students understand the question but cannot transform it into mathematical expression this type of error is classified as transformation error.

Process Skill Error: If the student make the mathematical expression but cannot identify the correct and do not know the procedure to carry out the solution this type of error is classified as process skill error.

Encoding Error: If the student make the correct solution to the question but cannot express this solution into acceptable written form this type of error is classified as encoding error.

Motivation Error: If the student decline to proceed further due to his/her psychological reasons this type of error is classified as motivation error.

Chapter II

REVIEW OF LITERATURE

Chapter Overview

This chapter describes the review of relevant literature relating to various aspects linking with error analysis on solving verbal problems. According to Wagle (1995). "Review of literature is an exacting task calling for a deep insight and clear perspective of the overall field. The main purpose of review of literature is to find out what work has been done in the field of the research studying being under taken" review of related literature is a previous source of the further study of research task which is the important, essential and helpful for guidance of research planning. It helps to conduct the new research in systemic manner by providing the general outline of the research study and avoid the unnecessary duplication. At the end, researcher justifies to the necessary of the study, finding gap in this fields and developing conceptual and theoretical framework.

Empirical Literature

We say errors committed when we believe that something happened is untrue, incorrect or wrong. That may be a departure from the accepted moral code or difference between computed and estimated result. Errors may have been committed because of lack of knowledge, ignorance or carelessness.

In literature errors, mistake, blunder, slip and lapse are synonyms with a meaning of departure from what is true, right or proper. Among them the word "error" is widely used in defining and analyzing the level of achievement of the learners. Errors suggest the existence

of failure to make effective use of right procedures, reasons being the lack of knowledge and competence.

Sharma (2009) studied "An error analysis in solving algebraic problems of grade five students" with aim to: Find the errors made by students in solving problem of simplification and equations of algebra and compare the error made by students in knowledge, skill and application and problem solving of simplification. All the students of grade V studying in Janata Primary School of Surkhet district in academic year 2065 were population of study and 30 students from defined population were included in the sample. The diagnostic test was developed and administered among the sample students by using Newman interview schedule and the main findings of this study were: The study shows that 75% of errors first occurred at the comprehension and transformation stage. The study shows that 12% of errors first occurred at the process skill stage. The study shows that 5% of errors first occurred at encoding stage. The study shows that 8% of errors occurred due to severe careless of students. The study shows that 40% of students committed errors on knowledge level. The study shows that 34% of students committed errors on skill and application level. The study shows that 26% of students committed errors on problem solving levels.

K. C. (2008) analyzed the error committed by the students of grade IX in geometric transformation. In his forward analysis more error was found in process and transformation. There were 26% errors found in transformation and process. According to his analysis the tendency of committing more errors were found in boys in comparison to girls.

Upadhyay (2011) studied on “the types of error mostly done by the students of grade V in janakpur 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.

Kafle (2006) studied on error analysis of the proof of the theorem in geometry in grade IX. The study revealed that students had committed number of errors in making proof of geometrical theories. The students committed errors from the beginning of the solutions to the deduction of the result. The concentration of the errors was seen on the reading and comprehension of the problem and in process skills. The data stated in the study shows that the students had felt difficulty in carrying out correct operations and did not follow correct procedure to carry out these operations accurately.

Pant (2005) studied on “computational errors of Grade – IV students on operation of fraction on Chitwan district”. The main finding of this study was; Students commit more errors in introduction of fraction than in addition of fraction. Students commit more error in subtraction than in addition of fraction. There is no effect of sex to commit the errors on the operation of fraction consider in her study.

Bhat (2003) studied on "An error analysis in quadratic equations at grade ten". This study was mainly focused on the identification and comparison of errors committed by grade ten students in quadratic equations. The main findings of this study were: There is no effect of location i.e. rural and urban school students committed equal number of errors on understanding, knowledge of solving and application of quadratic equation. The role of gender is less important to commit errors in understanding knowledge of solving and application of quadratic equations. The types of school (Private and public) are one of the causes to commit less or more error in knowledge of solving and application of quadratic equations. Students commit more errors in simplification process and comprehension. Students commit more errors in formulation rather than solving the quadratic equation.

Marahatha (2002) studied on “A Study on computational Error in Fraction by Grade VI Students in Chitwan District”. The main findings were:

i. Students generally commit more error in addition of fraction than in introduction of fraction. Thus the conclusion was derived from the result of null hypothesis in which the error mean was higher in addition of fraction than in the introduction of fraction.
ii. The mean error occurring in addition of fractions and subtraction of fractions were the same. It can be concluded that the grade VI students had the same difficulty in addition of fractions and subtraction of fractions.
iii. The mean error in multiplication of fraction is higher than introduction of fraction.
iv. Student’s higher error in divisions of fractions than in multiplication of fraction.
v. Errors are higher in division of fraction than introduction of fraction.
vi. There is no effect of sex to commit the errors in areas of operation of fraction considered in this study.

Poudel (2002) concludes in the masters degree thesis entitled "the occurrence of errors while solving words problems in mathematics by the lower secondary pupils" and found that:

i. There were 4.88 percent reading error, 6.37 percent comprehension errors, 52.44 percent transformation errors, 41.89 percent process skill errors and 24.42 percent encoding errors.
ii. Boys committed less error than the girls.

Sharma (2000) has analyzed the errors committed by the grade IX students in question formation. Her study portrays that the students committed more errors in wh-question formation than yes-no question formation. They committed the highest number of errors in verb from and those lowest misinterpretations of instructions.

Adhikari (1999) analyzed the errors committed by the students of the grade IX in the use of causative verbs. He has analyzed the errors in tenses “wrong use of structure in the causative verbs, in appropriate selection of the verb, in appropriate selection of the subjects and errors in implements etc. According to his analysis the tendency is more committing more errors were found in girls in comparison with boys.

Angdambe (1997) explained in his master degree thesis entitled “A Study on Computational Errors of Grade V Students on Operation of Fraction in Terathum District” and the found that;

ii) There is no effect of sex in committing errors in areas of operations of fraction.

iii) Students commit more error in comprehension of process of addition and subtraction.

Ellerton and Clements (1996) carried out Newman interview with 116 students of eight year]s in twelve classes of five school in New south Wales and Victoria. They found that 80% of the errors occurred at the process skill state. They also reported that different questions produced quite different error patterns. Thus for example; for the following question, forty percent of the error were the process skill variety and only fifteen percent were in the reading or comprehension or transformation categories. Ice- cream cost 85 percents each, and apple cost 45 percents each, how much altogether would 7 ice- creams and 5 apples.

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

Pandit (1992) studied the computational errors by learning disabled children in mathematics in the topic introduction, addition and subtraction of fractions. But the students did not identify the computational errors committed by non-disabled students in mathematics.

Schens (1983) investigated interaction effect on achievement, retention, attitude towards the fraction and attitude towards treatment of seven aptitudes from Guilford's SI model with figural inductive, verbal selective presentation of concepts of common fractions to the remedial mathematics students of Theodore Roosevelt high school located in a working lower classes neighborhood of the Bronx, New York. Several pre-test were given including two test of each of the Stanford aptitude test on fraction except for first type of tests for which a single vocabulary test is a sufficient measure.

Newman (1977a) studied on one hundred and twenty four low achieving grade six pupils and found that reading, comprehension and transformation errors made by low achieving pupils accounted for 13%, 22%, and 12% respectively. Thus almost half of the errors occurred in the first three steps.

Engelhardt (1977) not satisfied with Roberts classification of error type, conducted a study to extend Robert's efforts identification and classification on computational error. He took an arithmetic test containing eighty four items among one hundred ninety eight third and sixth grade students. The items identified as having incorrect responses were analyzed to understand students approaches or misconception leading to those responses according to commonalities these influences were clustered to form error type. There procedure resulted in the identification of eight type of error these were basic facts inappropriate inversion. Grouping incorrect operation, defective incomplete algorithm identifies zero error.

Filling the Gaps

From above empirical literature study, it is clear that in Nepalese context no specific study has been carried out on the error analysis in solving verbal problems on co-ordinate geometry. So, it is expected that this study will fulfill the research gap prevalent in co-ordinate geometry in Nepal and will be pioneer to the suited research area.

Theoretical Framework

Newman (1977), an Australian language educator who in the mid- 1970's developed systematic procedure for analyzing error made by students responding to written mathematics tasks. The finding of these studies have been sufficiently different from those produced by other error analysis procedures to attract considerable attention from both the international body of mathematics education researchers and teachers of mathematics.

Clements (1980) illustrated the Newman technique with a diagram. According to Clements (1989) errors due to the form of the question are essentially different from those in the other categories because the source of difficulty resides fundamentally in the question itself rather than in the interaction between the problem solver and the question. This distinction is represented in the figure by the category labeled "question form" being placed besides the five step hierarchy. Two other categories "carelessness" and "motivation" are also shown as separate form of hierarchy because as indicated, such error can occur at any stage of the problem solving process. A careless error, for example, could be a reading error, a comprehension errors and so on. Similarly, who have read, comprehended and worked out an appropriate strategy for solving problem might decline to proceed further in the hierarchy because of lack of motivation. For example, a problem solver might exclaim "what a trivial problem I can't be bothered doing it"

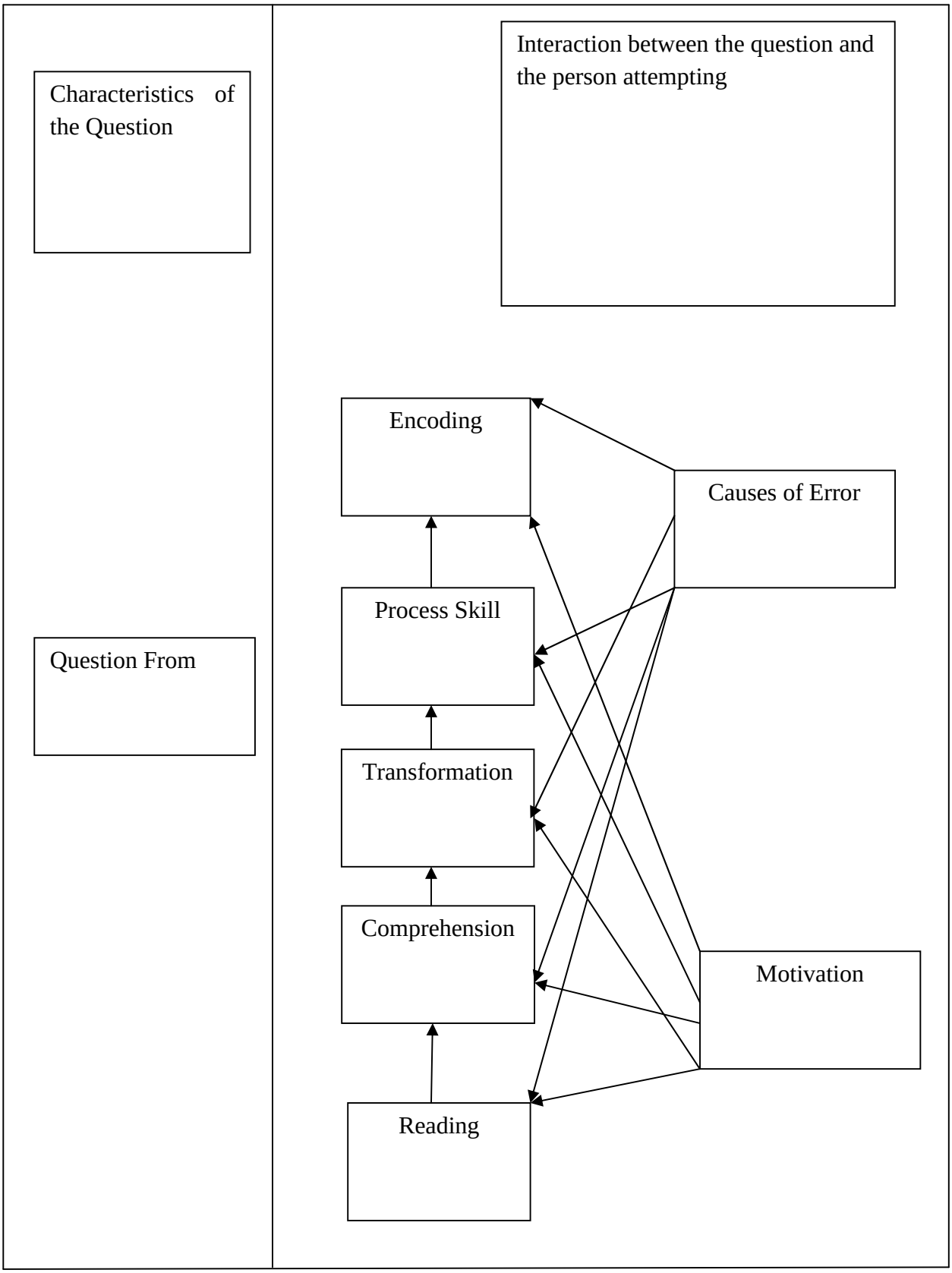

Characteristics of the Question
Interaction between the question and the person attempting
Encoding
Causes of Error
Process Skill
Question From
Transformation
Comprehension
Motivation
Reading

Fig: The Newman Hierarchy of Errors and Causes (Newman, 1983)

Newman (1983) recommended the following way to classify students' error on mathematical tasks.

1. Please read the question to me (reading)
2. Tell me what the question is asking you to do (comprehension)
3. Tell me what a method you can use to find an answer to the questions (Transformation)
4. Show me how you can use to find an answer to the question explain to me what you are doing as you do it (process skills)
5. Now write down your answer to the question (Encoding)

If an incorrect response is given to question then error is classified according to where the first "breakdown" occurred in the attempt to get a solution. If pupils who originally got a question wrong got 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 on whether the original errors could be attributed to carelessness or motivational factors. Newman recommended five types of errors. They are as follows:

Reading Error

Comprehension Error

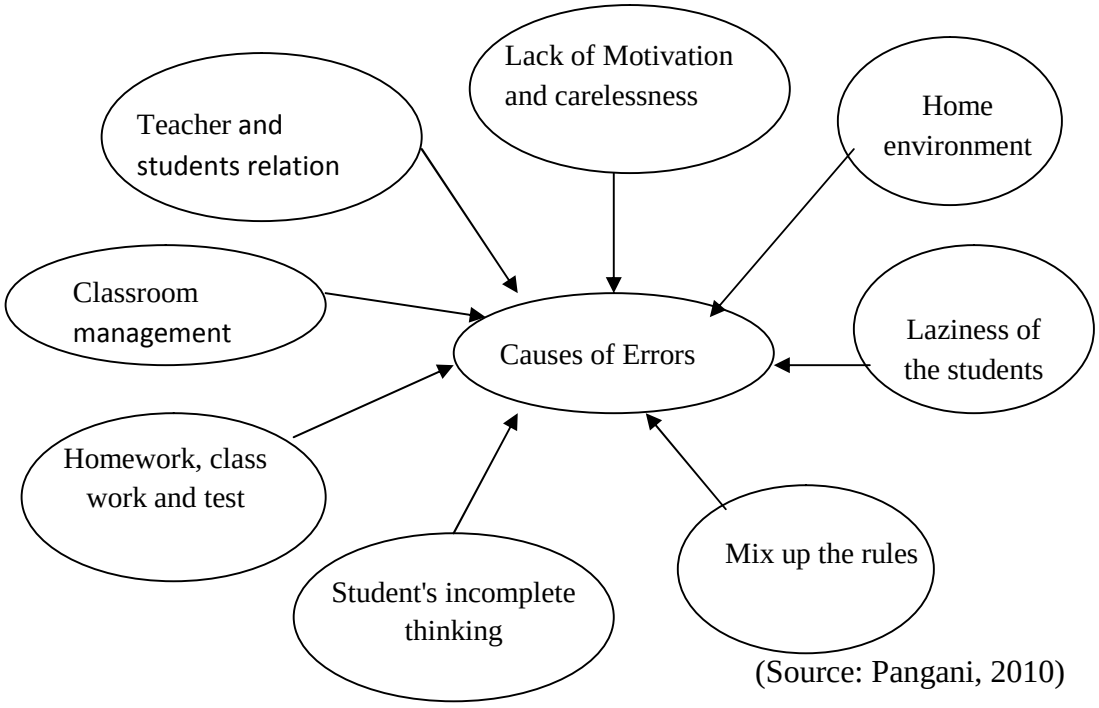
Transformation Error

Process Skill Error

Encoding Error

Framework of the Study

In the case of solving verbal problems, word problems are first transformed into mathematical problems and solution procedure is applied. This study was related to solving verbal problem on co-ordinate geometry. The researcher has applied Newman's errors analysis technique to find out the types and frequently of errors committed by the students while solving verbal problems on co-ordinate geometry and causes of those errors.



(Source: Pangani, 2010)

Chapter III

METHODS AND PROCEDURES

Chapter Overview

This chapter provides information about overall procedure to be followed to achievement the aims of the research. This section starts with design of the study along with sample of the study, tools, procedure of data collection. This chapter and with way to data analysis procedure.

Design of the Study

Research design is the conceptual structure, strategy of the logical and systematic planning and direction of research. It is a path through which a researcher gets to the goal of research. It is needed to complete the research in time. Framework for the research is drawn by research design. Research design guides the researcher to collect data, interpret and analyze the data. The descriptive survey method was adopted for this study. The design of this study is quantitative and qualitative. Newman's technique of error analysis was the theoretical base of this study.

Sample of the Study

Four government schools of Dhanusha district were selected purposively. The sample students were selected purposively with the consultation with mathematics teacher. Mathematics teachers of selected schools were also the sample to fulfill the objectives of the study. The objectives of this study were to find out the errors and to find the causes of the errors made by the students .So, both the below average and above average students were chosen as the sample of the study, average here means the average mark on the final test of

grade nine in mathematics. In the sample there were 120 students with 60 boys and 60 girls; 15 boys and 15 girls from each school. They were selected by the help of their regular mathematics teacher. Again mini-sample of 20 students was selected from the sample students for the interview to fulfill the second objective. These 20 students were taken on the basis of problem solving test.

Tools of the Study

To collect the valid data the researcher developed two types of tools. They were problem solving test and interview schedule.

a. Problem solving test: From the text book of optional mathematics of grade ten, ten questions were prepared. For the validity and reliability of the test items pilot survey was conducted on the sample of ten students. Out of ten questions, five questions were included on the final test and remaining other questions were removed.

b. Interview schedule: To fulfill the second objective of the study two types of open ended interview schedule were developed i.e. (i) Interview schedule for the sample students (ii) Interview schedule for the sample teachers.

Validation of Tools

The content validity of the test was established by its approval from the mathematics education experts, (Professor from Tribhuvan University Central Department) school teachers and thesis advisor. For the reliability of the test, the investigator carried out pilot study of the test prepared. 20 students of Shree Shanker Secondary School, Dhanusa were used for pilot study. Before administering the test paper, the investigator instructed the students how to respond the test.

Procedure of Data Collection

The researcher visited each of the selected secondary school in order to administer the test. Identification of error was very difficult task. Two types of tools were used to fulfill the objectives by the researcher. The first test was taken by students as problem solving test where the students had to solve the verbal problem in the answer sheet. Identification of error was really tough job because it should be categorized according to Newman technique of error analysis. It was impossible to find out the reading error and comprehension error through the answer sheet. So, interview was conducted to identify those errors. Next, to fulfill the second objective of the study, another interview was conducted by using interview schedule on mini- sample of 20 students.

Data Analysis Procedure

The error committed by the sample students were tabulated according to different types of errors described by Newman. The collected data were analyzed by quantitative method and percentage also used to analyze the data more easily, the data which was collected for the second objective of the study was analyzed without any specific theoretical base. Causes which were given by the sample students and teachers were arranged and described with the help of supervisor of this study.

Chapter IV

ANALYSIS AND INTERPRETATION

Chapter Overview

In this chapter, the collected data (error committed by students) were analyzed and interpreted. While collecting data; the students were provided with test to find out the mistake in their answer sheet. Here the mistake was taken as an error. Interview was conducted to find out the error which was impossible to find out by answer sheet. Second, interview was conducted on mini-sample of 20 students and mathematics teachers of the sample schools to find the causes of errors made by the students. Errors committed by the students during problems solving test were classified according to Newman's techniques of errors analysis.

Classification of Error of Verbal Test Item

In this section, errors made in problem solving test are classified according to the Newman's technique of error analysis. The whole errors are presented in the Table 1 and further elaborated in 2. Errors are classified into five categories which are: reading error, comprehension error, transformation error, process skill error and encoding error. Errors in each of the test item were classified and presented in percentage. In verbal test, 5 test items were carried out from grade ten, co-ordinate geometry topic in which 3 from the concept of angle between two straight lines, 1 from the concept from equation of a pair of straight lines and 1 from the concept of circle. 141 errors were noticed in verbal test items. In each test item different number of errors was found out which are as follows:

Table 1: Distribution of Errors Committed in Test

S. No.	Test Items	No. of Errors	Percent (%)
1	Find the acute angle between the two lines 2X-Y+3=0 and X-Y-2=0.	111	26.24%
2	Find the equation of a straight line which is parallel to the line with equation 5X-4Y-3=0 and passes through a point (2, 3).	99	23.40%
3	Find the equation of a straight line which is perpendicular to the line with equation 5X+7Y+12=0 and passes through a point (7, 1).	96	22.70%
4	Find the equation of two lines represented by equation X^2-5XY+$6y^2$=0.	42	9.93%
5	Find the equation of a circle with the center (5, 2) and radious 5.	75	17.73%

Table no. 1 shows that students felt difficulty in question number 1 because they did 26.24% error. Question number 1 was asked from the concept of angle between two straight lines. In which, there was given two equations of two straight lines and students needed to find out the angle formed from those two straight lines. Question no. 2 was also asked from the concept of angle between two straight lines in the students 33 errors were made by the students. Question three was based on the concept of angle between two straight lines on which students were given a equation of a straight line and a point from which another straight line passes; students were to find out the equation of the second straight line. They had made 22.70% of error in question number 3. Question number 4 was based on the concept of equation of a pair of straight lines on which students made 9.93% of error. Question number five was based on circle and students were needed to find the equation of a circle with given

center point and radious on which they made low error (i.e. 17.73% of error) in comparison with first three questions.

Classification of Error According to Newman Technique of Error Analysis

Students had to cross various steps to solve the verbal problem; several errors might be committed in that step. According to Newman, while solving the verbal problem, five types of error might be committed. Newman has categorized it into reading error, compression error, transformation error, process error and encoding error. Errors found in question while implementing test were categorized according to Newman's technique of error analysis. Errors were collected from interview too. The error was kept in reading error when the students were unable to read the question properly. This error was found out by giving them question to read. The error was kept under the comprehension error when they were unable to receive what the question asked. It was found out through answer sheet and interview. The error was kept under transformation error, when the students were unable to change word problem into mathematical expression. The error was kept under process error when they committed error in processing the answer. At last, the error was kept in encoding error when they committed the error in verbal answer. In this way, the errors are categorized in the following table.

Table 2: Distribution of Errors According to Newman's Technique

	Types of Error					**Total**
	Reading	**Comprehension**	**Transformation**	**Process**	**Encoding**	
No. of Errors	36	111	84	144	48	423
Percent	8.51%	26.24%	19.86%	34.04%	11.35%	100.00%

From the above table no. 2 errors are very few in reading and more in process. 8.51% of errors were committed in reading whereas 34.04% of errors were committed in the process. 26.24% of errors were committed in comprehension. On the other hand 19.84% and 11.35% errors were committed in transformation and encoding respectively.

In conclusion, students felt fewer problems in reading but more in comprehension and process.

Classification of Errors Occurred in Question No. 1 (Concept of Angle between Two Straight Lines)

Question no.1 was asked from angle angle between two straight lines. The question was " Find the acute angle between the two lines 2X-Y+3=0 and X-Y-2=0. Here we be seen there are two equations of straight lines and students needed to find out the angle formed with these straight lines with the help of formulae on co-ordinate geometry. Students also needed to take help from a given table or scientific calculator to find out the degree of angel. But many errors were committed.

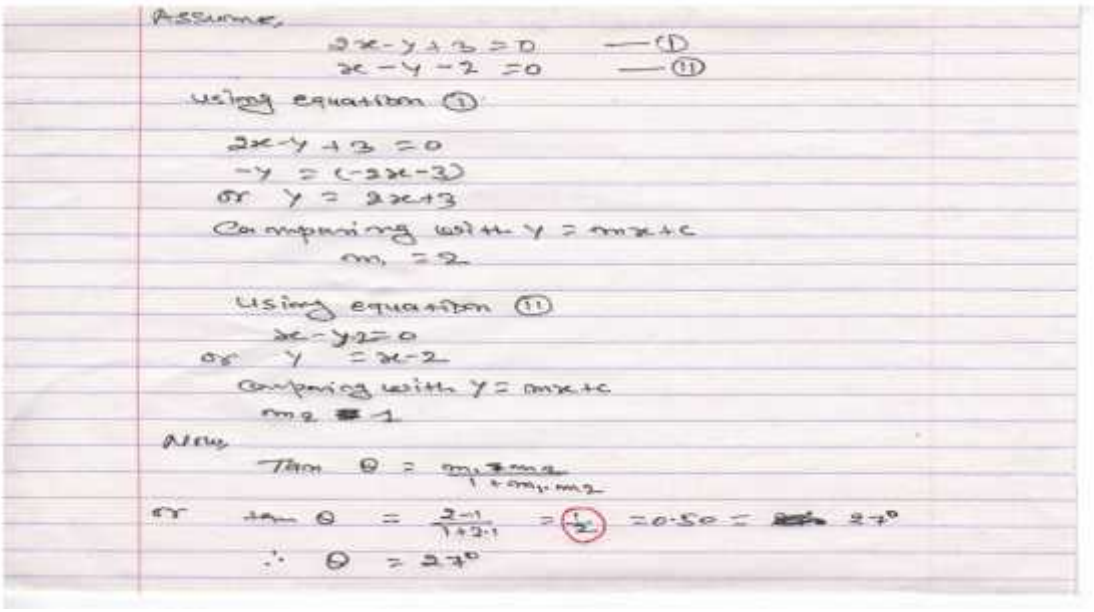
Table 3: Classification of Errors Occurred in Q. No. 1

	Types of Error					**Total**
	Reading	**Comprehension**	**Transformation**	**Process**	**Encoding**	
No. of Errors	12	30	18	42	9	111
Percent	10.81%	27.03%	16.22%	37.84%	8.11%	100.00%

From the analysis of table no. 3, 111 errors were found in question 1 out of 423. According to Newman technique of error analysis, 10.81% of reading error was found which was few and 37.84% errors were found in process which was very high. Likewise, 27.03%, 16.22% and 8.11% of errors were found in comprehension, transformation and encoding

respectively. In conclusion, this problem was felt less difficult in reading and more difficult in process. There was lack of practicing the problem.

In the question no. 1 " Find the acute angel between the two lines 2X-Y+3=0 and X-Y-2=0" a process error committed by one of the sampled student named Ruj Kumar Maheto was as under:



Classification of Errors Occurred in Question No. 2 (Concept of Angle between Two Straight Lines)

Question no. 2 was also asked from the concept of angle between two straight lines. The question asked was " Find the equation of a straight line which is parallel to the line with equation 5X-4Y-3=0 and passes through a point (2, 3). In this problem students needed to find the equation of a straight line which is parallel with given equation and passes through the given point. The error committed in this question has been presented below in Table 4.

Table 4: Classification of Errors Occurred in Q. No. 2

	Types of Error					Total
	Reading	**Comprehension**	**Transformation**	**Process**	**Encoding**	
No. of Errors	9	27	21	36	6	99
Percent	9.10%	27.27%	21.22%	36.35%	6.06%	100.00%

Table no. 4 shows that 99 errors were committed in question number 2 which was 23.40% out of 423 errors. Centering in question 2, 9.10%, 27.27%, 21.22%, 36.35% and 6.06% errors had been found out in reading comprehension, transformation, process and encoding respectively. In which more error was found in process which was more than one third means 36.35% of error. In conclusion, there were fewer problems in reading and more problems in processing.

Classification of Errors Occurred in Question No. 3 (Concept of Angle between Two Straight Lines)

Question no. 3 was based on the concept of angle between two straight lines. The question asked was "Find the equation of a straight line which is perpendicular to the line with equation 5X+7Y+12=0 and passes through a point (7, 1). The error committed in this question has been presented below in Table 5.

Table 5: Classification of Errors Occurred in Q. N. 3

	Types of Error					Total
	Reading	**Comprehension**	**Transformation**	**Process**	**Encoding**	
No. of Errors	9	24	21	30	12	96
Percent	9.38%	25.00%	21.88%	31.25%	12.50%	100.00%

Table no. 5 shows that very few errors have been committed in reading. The central focus of error was found in process. From the analysis of table no. 5, 96 errors were found in question 3 out of 423. According to Newman technique of error analysis, 9.38% of reading error was found which was few and 31.25% errors were found in process which was very high. Likewise, 25.00%, 21.88% and 12.50% of errors were found in comprehension, transformation and encoding respectively. In conclusion, this problem was felt less difficult in reading and more difficult in process. There was lack of practicing the problem.

Classification of Errors Occurred in Question No. 4 (Concept of Equation of a Pair of Straight Lines)

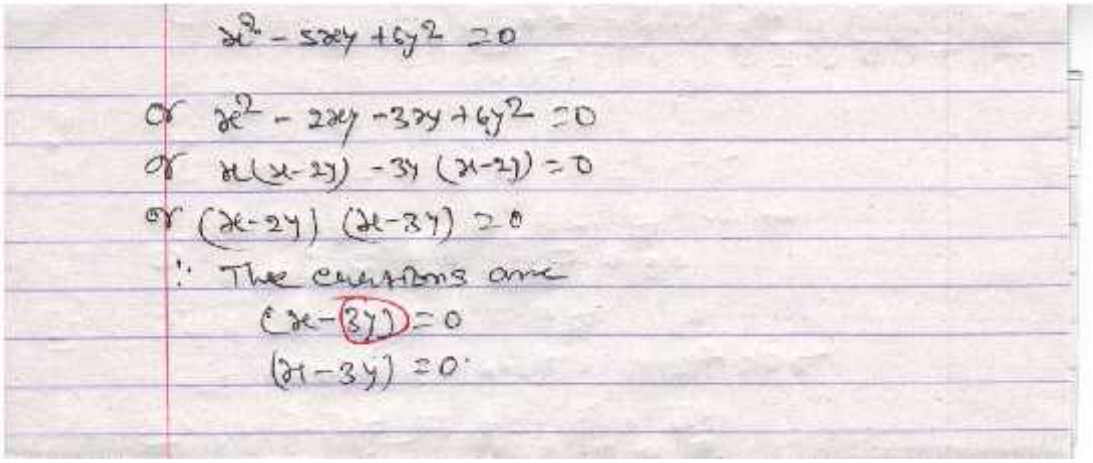
Question No.4 was asked from the concept of equation of a pair of straight lines. The question asked was " Find the equation of two lines represented by equation X^2-$5XY+6y^2=0$". Here, we can see a equation formed with two different equations. The equations represent two different lines. Students needed to find out those different equations. The error committed in this question has been presented below:

Table 6: Classification Errors occurred in Q. N.4

	Types of Error					**Total**
	Reading	**Comprehension**	**Transformation**	**Process**	**Encoding**	
No. of Errors	3	12	6	9	12	42
Percent	7.14%	28.57%	14.29%	21.43%	28.57%	100.00%

Table no. 6 shows that comparatively low numbers of errors were committed in question no.4. Only 42 errors were found out of 423. In conclusion, there was no problem in reading. It was seen more problematic in comprehension and encoding.

In the question no. 4 "Find the equation of two lines represented by equation X^2-5XY+$6y^2$=0" an encoding error committed by one of the selected students named Shanker Thakur was as under:



Classification of Errors Occurred in Question No. 5 (Concept of Circle)

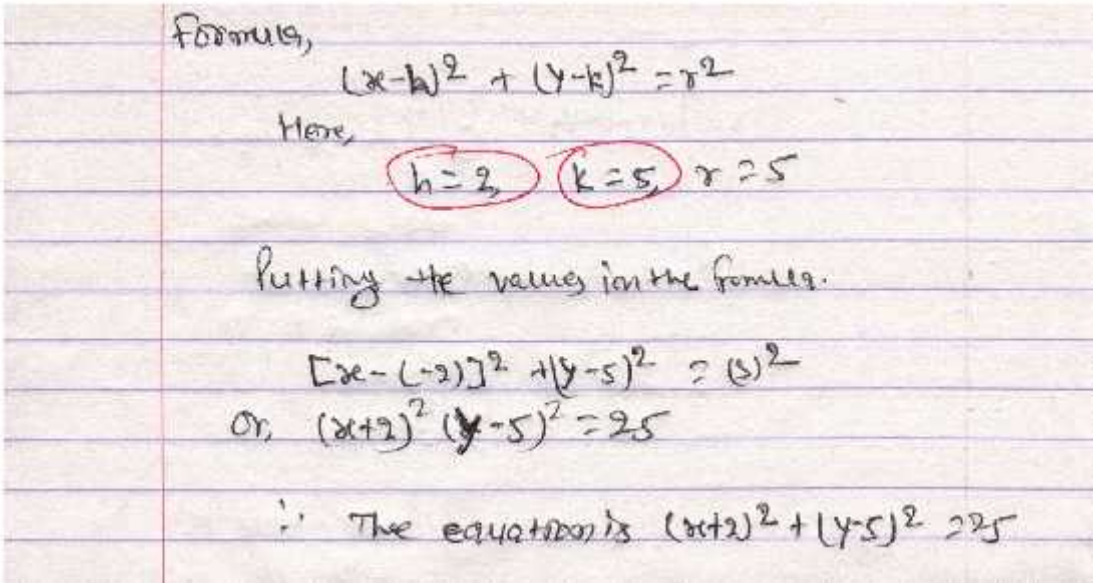
Question no. 5 was the last question, which was asked from the concept of circle. The question asked was "Find the equation of a circle with the center (5, 2) and radious 5". Students felt difficulty and made several errors, which are presented in the table below.

Table 7 : Classification of Errors Occurred in Q.N. 5

	Types of Error					**Total**
	Reading	**Comprehension**	**Transformation**	**Process**	**Encoding**	
No. of Errors	3	18	18	27	9	75
Percent	4.00%	24.00%	24.00%	36.00%	12.00%	100.00%

The above table shows that 75 errors were committed in question number 5. Medium number of errors was committed in this question. From this, it is clear that the question number 5 was comparatively easier. Only 3 error was made in reading and 27 errors were made in process.

In the question no. 5 " Find the equation of a circle with the center (5, 2) and radious 5" an encoding error committed by one of the selected students named Rajesh Sha is presented below as an example of transformation error:



After tabulation and calculation of the data obtained by verbal problem solving test and interview with sample students the process of findings the errors in verbal problem solving test on co-ordinate geometry was over. At the time of analyzing the researcher concluded that the students commit less number of errors on reading and more error in process stage of solving verbal problem into the mathematical expression. Similarly, students committed transformation error, comprehension error and encoding error respectively.

Causes of Errors Committed by the Students in Verbal Problem Solving

The second objective of this study was to find out the causes of errors committed by the students while solving verbal problem in co-ordinate geometry. Errors were identified and classified through the test. Next, the researcher had to find causes. It was very difficult task. On the problem solving test students were committed number of errors. These errors were classified and analyzed on the basis of Newman's technique of error analysis. To find the

causes of error interview was conducted on the mini-sample students and mathematics teacher of the sample schools. Some suggestions were collected from the guide of this research. At the time of interview sample students felt a bit difficulty to present their view because they were seen unable to give the causes why they made error on solving verbal problem themselves. The different views or causes presented by the students about the errors on solving verbal problem were sum up on the following points.

- Less reading.
- Less concerning.
- No degree of repetition.
- Unfamiliar to the subject matter.
- Lack of chance to read at home.
- The teacher should not teaches properly.
- Lack of word meaning.
- Bad relation to the teacher.
- Lack of knowledge of previous class.
- Less manage classroom.
- Test phobia.
- Mother-tongue.
- Laziness.
- Large class size.
- Lack of teaching learning materials.
- Lack of confidence of mathematics teachers
- Noisy classroom.
- Lack of motivation by mathematics teacher.

On the other hand, some similarities and some differences were found on the view of teachers about the causes of errors committed by the students. Interview was conducted on the basis of five types of errors committed by students in first test. Views of teachers or causes presented by the teachers were arranged on the following heading.

- Causes of reading error.
- Causes of comprehension error.
- Causes of transformation error.
- Causes of process skill error.
- Causes of encoding error.

Here only those views are coated which are logically powerful in observation of researcher.

Causes of Reading Error

The error was kept in reading error when the students were unable to read the question properly. This error was found out by giving them question to read. Only 8.51% of error was committed by the students in verbal problem solving test and interview which was conducted by the researcher. At the time of interview about the causes of reading error mathematics teacher of Shree Janaki Madhyamik Bidhayalaya told that:

> *Students commit reading error because of hesitation with the teacher and peer group they feel weak themselves and sometime test- phobia.*

The mathematics teacher of Shree Sakal Bhawar Kanya Madhayamik Bidhayalaya told that:

> *Students have difficulty in reading the question due to the lack of knowledge of technical term in mathematics.*

Besides the above statements the following were also mentioned by them as the causes of reading errors.

- *Most of the errors are committed by the students because of poor background in language.*
- *Less important is given on reading question in classroom by the mathematics teacher.*
- *Lack of knowledge to recognize the symbols which are used in mathematics.*
- *Reading error occurs due to the unclear voice of respondents.*
- *Students commit reading error because some of them learn Nepali as the second language and English as the third language but daily practice they use their mother tongue.*

In conclusion, hesitation, poor background of language, knowledge of technical terms, symbols, voice, etc. are the responsible causes of reading errors. Teachers need to encourage the students; teachers should pay special attention to the language. Sometimes reading verbal problem competition should be run by the mathematics teacher to minimize the reading errors.

Causes of Comprehension Error

The error was kept under the comprehension error when students were unable to receive what the question asked. It was found out through answer sheet and interview. Students were committed 111 errors out of 423. It was about 26.24%. At the time of interview about searching the causes of comprehension errors, mathematics teachers of Shree Sankat Mochan Higher Secondary School told that :

The students who have difficulty with comprehension are due to monotonous environment of classroom.

The mathematics teacher of Shree Sarasawati Madhayamik Bidhayalaya told that:

Some students are confused on the meaning of the words used in verbal problems by attaching their own meaning to them.

Besides the above, the following were also mentioned by them as the causes of comprehension errors.

- *Some students perform the comprehension error due to the lack of pre- requisite knowledge.*
- *Students have difficulty in comprehension due to the lack of knowledge of technical term in mathematics.*
- *Some students perform comprehension error due to the bad relation with the mathematics teacher.*
- *Lack of classroom management and noise.*
- *Tension at home is also one of the causes of comprehension error.*
- *Partial attention to the teacher's explanation.*
- *Students only listen in class but do not participate in discussion.*

In conclusion, after studying the above statements presented by the different mathematics teachers the researcher draw that comprehension error occurred due to monotonous environment, own meaning, lack of knowledge of technical terms, lack of attention to the teacher's explanation. To minimize the comprehension error the mathematics teacher need to give fundamental knowledge about the topic before starting the new chapter. Opportunity should be given to the students to express the question in their own words after reading.

Causes of Transformation Error

An error was classified as transformation error if the students had understood what the question about but was unable to express that in mathematical expression and unable to identify the operation or sequence of operation needed to solve the problems. Medium numbers of errors were committed by the students in this level i.e. 84 out of 423, which is about 19.86%. It was found through the answer sheet. At the time of interview the mathematics teacher of Shree Saraswati Madhyamik Bidhyalaya told that:

> *Teachers teach the verbal problems with some explanation and ask the general and regular question like; understood? Most of these questions are answered in chorus fashion; yes sir, but rarely do they think about concepts, meaning and reasoning. So, the students commit transformation errors.*

The mathematics teacher of Shree Janaki Madhayamik Bidhayalaya told that:

> *In attempt to make things easy for the students some teachers have given incomplete explanation by focusing on certain salient feature that illustrate only some of the features of the concept.*

Besides the above, the following were also mentioned by them as the causes of transformation errors.

- *Students commit transformation errors due to the lack of concept and meaning of the mathematical words.*
- *Students commit transformation error because teacher focuses on the calculation but do not give emphasis or do not explain about the question properly.*
- *Students commit transformation error because of lack of pre-requisite knowledge of their previous classes.*
- *Transformation error occurs due to unable to identify the correct operation to solve the problem.*
- *Lack of classroom discussion.*

In conclusion, transformation errors are occurred due to incomplete explanation, unclarifying the problem, lack of mathematical concept, skill and more emphasis on calculation part on mathematics. To minimize the transformation error the teacher should give clear concept about mathematical terms which are used in respective topic.

Causes of Process Skill Error

An error was classified as process error when a student was unable to identify the correct operation and did not know the procedures to carry out these operations accurately. In verbal problem solving test students committed 144 errors out of 423. It was 34.04%. It was found out through the answer sheet of the test.

At the time of interview, the mathematics teacher of Shree Sakal Bhawar Kanya Madhayamik Bidhayalaya told that:

> *Students often mix-up rules because they do not really have relation understanding of what they are doing.*

The mathematics teacher of Shree Sankat Mochan Higher Secondary School told that:

Students are often trained to follow instruction meticulously seldom supported by conceptual justification. They do not think of alternatives and are uncomfortable with them.

The mathematics teacher of Shree Saraswati Madhayamik Bidhayalaya told that:

Sometimes the students pay only partial attention to the teacher's explanation as a result of boredom, tiredness or monotonous tone of teacher consequently they can recollect only part of explanation and then try to patch it up with their logic which may be faulty.

Besides the above presented statements there were some other causes which were given by mathematics teacher.

- *Lack of teaching materials which are used in teaching verbal problems in co-ordinate geometry.*
- *Lack of practice to solve the verbal problem at home and outside.*
- *Lack of mathematical skill which are essential to solve the verbal problem.*

In conclusion, from the study of above statements the researcher found that process skill error is occurred due to mix-up of rules, lack of thinking alternative, not listening the teacher explanation properly, less practicing the problem. To minimize the process skill errors teachers must force the students to solve the problem time and again.

Causes of Encoding Error

An error was classified as encoding if the students correctly worked the solution to the problem but could not express the solution in an acceptable written form. In test students were committed 48 errors out of 423. It was about 11.35%. It was the second less percent in the test. It was found out through the answer sheet of problem solving test.

At the time of interview, the mathematics teacher of Shree Janaki Madhyamik Bidhayalaya told that:

Most of the teachers as well as students focus on findings the answer of the problem but they do not take care about keeping the solution procedure in order.

The mathematics teacher of Shree Sankat Mochan Higher Secondary School told that:

Sometimes teacher solves the mathematical problem in up- down, left right (i.e. not in sequence) due to lack of blackboard and students copy the same. Students may follow the same in solving other problems too. So, encoding errors occur.

Beside the above mentioned statements there were other statements which were given by the sample teachers.

- *Encoding error occurred due to the carelessness of students.*
- *Sometimes limitation of time in test,*
- *Lack of homework and class work checking.*

In conclusion, encoding error is occurred due to carelessness, importance is given to finding the answer and less important to arranging the procedure.

Chapter V

SUMMARY, FINDINGS, CONCLUSION AND RECOMMENDATION

Chapter Overview

This chapter deals with the summary, findings, conclusion and recommendations concerning the analysis of error of co-ordinate geometry in grade ten. This chapter is divided into four sections; summary, finding, conclusion and recommendation of the study.

Summary

The study was aimed at fulfilling two objectives. They were to find the errors committed by students of grade ten in solving verbal problems on co-ordinate geometry and to find the causes of error made by the students. The sample in this study consisted of forty students from four schools of Dhanusha district. The schools were purposively selected. Newman technique of error analysis was adopted as the theoretical base of this study. Verbal problem solving test was adopted. Test consisted of five questions. Errors from the test were analyzed by applying Newman technique of error analysis. Collection of data was done in two ways. In first way errors collected from the answer sheets. In second way the errors were collected by interview and causes of error also collected through interview. From the verbal test all the identified errors were classified into five categories as described by Newman and frequency of each type of error was tabulated. The five categories of the errors were reading error, comprehension error, transformation error, process error and encoding error. If a student could not read the key word in the written problem such error was labeled as reading error. An error was classified as comprehension error if the student could not grasp the overall meaning of the words and therefore unable to understand the meaning of the problem. An error was counted as transformation error if the students was unable to identify the

sequence of operation needed to solve the problem. When a student did not know the procedure to carry out the operation accusatorily then process error was committed there. At last an error was classified as encoding error of the students if correctly worked out the solution to the problem but could not express the solution in a acceptable written from. The errors in each of five problems were classified and later the errors in total were tabulated and discussed. To fulfill the second objective of the study interview was conducted with the mathematics teachers of the sample schools. Different views presented by different teachers on different types of errors were arranged and discussed.

Findings

The main findings of this study are followings:

i. The total number of errors committed by the students in solving verbal problems was 423. These errors were tabulated by checking answer sheets and by taking interview. Out of 423 errors 36 from reading, 111 from comprehension 84 from transformation, 144 from process and 48 from encoding.

ii. Student had average knowledge of angle of two straight lines, equation of a pair of straight lines and circular. They were found to be curious on the co-ordinate geometry. The needed more practice. So, many errors were found while solving verbal problem in co-ordinate geometry.

iii. In verbal problem solving test, least errors were found in reading and most of the errors were found in comprehension and process.

iv. In test question number four was seen easy in which 9.93% of error was occurred and question number one was seen difficult in which 26.24% of error was occurred.

v. Students have difficulty in reading and understanding the question due to lack of knowledge of technical term in mathematics.

vi. Most of the errors are committed by the students because of poor background in language.

vii. Some students are confused on the meaning of the words used in verbal problem by attaching their own meaning to them.

viii. Students often mix-up rules because they do not really have relational understanding of what they are doing.

ix. Using salient features by the teachers on teaching verbal problem restrict the students from compete understanding of the verbal problems.

x. A conformist attitude restricts the students from alternative ways of solving verbal problems.

Conclusion

The main objectives of the study were to find the types of error committed by students of grade ten on co-ordinate geometry and to find the causes of error. According to the objectives of the study the data and information were collected and analyzed.

From the study it is concluded that: the students commit errors from the beginning (reading level) to the deduction of result (encoding level) the concentration of error was seen on the process level where the students committed 34.04% errors. This result shows that maximum number of students were failed in the stage of processing the mathematical problem due to lack of knowledge of proper process and practice. Next concentration of errors was on comprehension level, where the students committed 26.24% errors. This shows many students have no idea about what the verbal problem asks from them and how to solve.

The researcher also tried to find out the causes of errors and found that students have difficulty with reading because of find it hard to establish a context for a particular text to predict the meaning of the text and anticipate words that are likely to occur within it. To assist these students, teachers can provide orientation to the text before they read the problem. The aim of orientation should be to make the students aware of the story in which the problem embedded, the context of problem, unusual language likely to cause difficulty for the students and mathematical words in the text of the problem. The students who have difficulty with comprehension are due to monotonous environment of the classroom, due to lack of knowledge of technical terms in mathematics.

Teachers teach the verbal problems with same explanation and ask the general and regular question like; understood? Most of these questions are answer in chorus fashion; yes sir, but rarely do they think about concepts meaning and reasoning. Another cause of comprehension error was found that the students attach their own meaning to some particular words. The students who have difficulty with transformation are due to lack of discussion in classroom. Students are not given ample opportunity to use their own method of solving the problems. The students who have difficulty with process due to mix-up rules because they do not really have relational understanding of what are they doing. Encoding errors are due to lack of regular practice of mathematical problem. It is lack of class work and homework.

The researcher found learning problems of students due to which they commit errors.

Some students are confused on the meaning of the words used in verbal problems by attaching their own meaning to them.

Sometimes the students pay only partial attention to the teacher's explanation as a result of boredom tiredness or monotonous tone of teacher. Consequently, they can recollect only part of explanation and then try to patch it up with their own logic which may be faulty.

Students often mix-up rules because they do not really have relational understanding of what they are doing.

In attempt to make things easy for the students some teachers given in complete explanation by focusing on certain salient feature that illustrate only some of the features of the concept.

Since students are often trained to follow instruction meticulously, seldom supported by conceptual justification, they do not think of alternatives and are uncomfortable with them.

When a teacher teaches, most students just listen the explanation and do not participate in the discussion. Teachers must involve the students in the teaching and learning process to do better in solving verbal problems. The teachers should give the orientation that provide sufficient guidance to solve the problem and should give the opportunity to do the problem students themselves.

Recommendations

Recommendation for educational implications. On the basis of findings and conclusion the following recommendations for educational implications are made.

- Before starting the chapter, the teacher has to give the fundamental knowledge about the topic.
- Students become puzzled when new chapter approaches to them at secondary level. So, any topic should be introduced from lower level.
- Most of the errors are committed by the students because of poor background in language. Teachers should pay special attention to the language. Mathematical concepts should be explained in detail by using simple language with illustration.

- The teacher should encourage the students to solve the problem through different ways
- Correction of errors should be down with the participation of students.
- Opportunity should be given to the students to express the question in their own words after reading.
- The teacher should try to find out the reason about committing the errors.
- The teacher should change teaching strategies after getting the causes of errors.
- Classroom management and teaching materials should be managed to minimize the error.

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APPENDICES

Appendix I

Problem Solving Test Questions

1. Find the acute angle between the two lines 2X-Y+3=0 and X-Y-2=0.
   दुई रेखाहरु 2X-Y+3=0 and X-Y-2=0 बिचको न्युनकोण कति हुन्छ ?
2. Find the equation of a straight line which is parallel to the line with equation 5X-4Y-3=0 and passes through a point (2, 3).
   5X-4Y-3=0 रेखासँग समानान्तर हुने र बिन्दु (2, 3) भएर जाने रेखाको समीकरण निकाल्नुहोस् ।
3. Find the equation of a straight line which is perpendicular to the line with equation 5X+7Y+12=0 and passes through a point (7, 1).
   5X+7Y+12=0 बिन्दु (7, 1) भएर र रेखासँग लम्ब हुने रेखाको समीकरण निकाल्नुहोस् ?
4. Find the equation of two lines represented by equation X^2-5XY+$6y^2$=0.
   X^2-5XY+$6y^2$=0 ले कुन कुन रेखाहरुको समीकरणलाई जनाउँछ ?

5. Find the equation of a circle with the center (5, 2) and radious 5.
   केन्द्रबिन्दु (5, 2) र अर्धव्यास 5 भएको वृत्तको समीकरण पत्ता लगाउनुहोस् ?

APPENDIX II

Guideline for the Interview with Mathematics Teacher

Respected Teacher,

I am a student of mathematics education in central department of mathematics education in Kirtipur. I am doing a research on *An Error analysis in solving Verbal Problem on Co-ordinate Geometry,* The main objectives of my research is to find out the errors committed by the students of grade ten and to find out the causes of errors. To fulfill the second objective of the study I would like to take your view and idea on why students commit errors. Your view and ideas are only used to complete this study not for other purpose. I hope you do not feel any difficulty to help me to complete my study.

Teacher's Name: Sex:

School's Name: Location of School:

Experience: Type of School:

Training:

Age:

- School environment.
- Students number.
- Physical facilities in school.
- Students qualities.
- SLC result in maths of previous year.
- Teacher students relation.
- Students participation in classroom activities.
- Class work and homework.

Special focus on:

- Causes of reading, comprehension, transformation, process skill and encoding errors.

APPENDIX III

Guideline for Interview with Mathematics Students

Name : Sex:

Class : Caste/ ethnicity:

Roll No: Place of birth:

Position in the class: Place of residence:

- Personal history.
- Parent's occupation and education.
- Opportunity to learn home.
- Classroom management.
- Teacher behavior in the classroom.
- Class work and homework.
- Punishment, rewards etc. provided by the mathematics teachers to students.
- Student, relation with mathematics teacher and school administrator.

APPENDIX IV

Sample School, Students and Teacher

S.N.	Name of Schools	Number of Students		Number of Teachers
		Boys	girls	
1	Shree Janaki Madhyamik Bidhyalaya	15	15	1
2	Shree Sakal Bhawan Kanya Madhyamik Bidhyalaya	15	15	1
3	Shree Sankat Mochan Higher Secondary School	15	15	1
4	Shree Saraswati Madhyamik Bidhyalaya	15	15	1

Appendix IV

Sample Students for Interview

S. N.	Schools Name	Number of Students		Total
		Boys	Girls	
1	Shree Janaki Madhyamik Bidhyalaya	3	2	5
2	Shree Sakal Bhawan Kanya Madhyamik Bidhyalaya	2	3	5
3	Shree Sankat Mochan Higher Secondary School	3	2	5
4	Shree Saraswati Madhyamik Bidhyalaya	2	3	5
Total		**10**	**10**	**20**