

## Chapter I

### Introduction

#### **Background of the study**

People have been using mathematics from the very beginning of human civilization. It is believed that mathematics was originated along with the origin of man. Human beings themselves created mathematics in the need for application to counting and measuring in relation to both of quantities. Mathematics usually develops as the need changes of human being.

The word Mathematics has been derived from an ancient Greek word "mathenein" which means "to learn" (William, 1972). Mathematics has grown with the development of humanity from its ancient civilization up to the modern civilization. Mesopotamia, Babylonia, Egyptian Roman and Greek civilization played central role in the development of mathematics as it is learned and used today. Now a day it is defined as an abstract representational system used in the study of numbers, shapes, structure, change and the relationships between these concepts (Oxford English Dictionary, 2008 AD). Also it has been defined as a science of number and space. Similarly Mathematics in a strict sense is the abstract science which investigates deductive the conclusion implicit in the elementary conception of spatial and numerical relations. Mathematics is also known as the science of logical reasoning. Similarly Mathematics is a way to settle in mind if children a habit of reasoning- Locke

Moreover, the term mathematics has been explained in various ways such as; it is numerical and calculation parts of man's life, is the science of number and their operation, interrelation and collection of skills and method to solve equation and to find unknown. I.e, algebra.

The word algebra is Arabic in origin etymologically it came from the word *al-jabr* muqbulab. Here "al" means "The", 'Jabr' refers to the operation of transferring quantities just from one side of an equation to another while 'maqbulab' means the process of while subtracting similar quantities from both sides of an equation. (<http://en.wikipedia.org/Algebra>)

Algebra is the generalization of arithmetic. It is also thought to be the most difficult and abstract of all branches of mathematics. But, it is primarily through for manipulative skills solution of problem through the equation, a power of generalization and use of formulation and idea of functionality. As it has been called generalized arithmetic so it can be related to geometry by saying that algebra is only written geometry and geometry is merely pictured algebra.

More analysis is necessary in order to develop a clear understanding of what factors help students to be successful in algebra and how schools and other systems can assist in achieving this goal. For this goal all students must know basic concept of algebra which is started from factorization (i.e. divisibility and multiples of different numbers and letters).

**Factorization (noun):** The etymological meaning of factorizations "factorize + action" in which it is the process of creating a list of factors or, an expression listing items that when multiplied together, will produce a desired quantity. In mathematics, factorizations is the decomposition of an objects (for example, a number, a polynomial or a matrix) into a product of other objects, or factors which multiplied together give the original, for example,  $15 = 3 \times 5$ ,  $x^2 - 4 = (x+2)(x-2)$  etc .

**Error:** All learners make error. Generally, an error means a simple lapse of care or concentration which almost everyone makes at least occasionally. In mathematics, an error means the deviation from a correct solution of a problem. In this study, an error is regarded as a mistake in the process of solving problem procedurally or by any other method. Errors could be found in wrongly answered problems which have flaws in the process that generated the answers (Young & O'Shea, 1981). Errors and mistakes are taken as synonyms in layman's sense. It will be happen by the incomplete knowledge and lack of attention, carelessness or some other aspects of performance. Errors no longer are taken as bad sign in learning in fact it is an important component in minimizing the error in learning process and developing competence. There are many type of error i.e. reading error, carelessness errors, comprehension errors, etc.

Moreover, from last few year, the researcher a secondary school teacher, the researcher observe many students in class struggling to cope with learning algebra.

They had a good arithmetic background, and they can solve a problem using lengthy arithmetic procedures that they came up with themselves, but were hesitated to use algebraic methods. The researcher try to use algebraic methods on own to motivate them. However, my attempts were not very successful as students used their own lengthy arithmetic procedures or rather failed in using algebraic methods.

By observing the students informally, the researcher found that they have some misconceptions at factorization. Sometimes, they repeatedly made the same error. Also, through discussion with my fellow teachers, the researcher realized that their explanations for these types of behaviors were surprisingly consistent with mine. However, one thing is clear to me these misconceptions are found at basic level of algebra. i.e. factorization. Whatever the reasons may be, there should be a way to identify and remedy these problems. The researcher also observed that these students memorized only a few facts and formulas without understanding them conceptually, This is one of my own explanations for the reasons of student errors in factorization and the researcher realize that this problem is common to many students. The researcher always think that there should be a systematic way of studying the errors and to see what students have to admit about their own mistakes. Thinking along this line, the researcher formed statement of the problem.

### **Statement of the problem**

As we know that algebra is one of the important parts of Mathematics at secondary level and factorization is a process to find the factors of an algebraic expression in product form, it is foundation for all the algebra in secondary school curriculum so the concept of factorization is much important to solve the algebraic factorization. But most of the students have felt that the factorization is much difficult to understand so this study mainly would concerned with the identification and comparison of error committed by the students. What type of error generally they commit while they learning? What are the difficulties faced by the students in learning? So this study is concern with the identification and diagnoses the errors committed by grade IX students in factorization. Hence, this study intent to find the answer of the following research questions:

1. What type of errors are made by the students while solving problem of factorization?
2. What are the causes of error do students in solving of factorization?

### **Objectives of the study**

The main objectives of this study were to identify error of grade IX students in factorization. The study was carried out to accomplish the following objectives:

- i) To find the types of error committed by grade IX students in solving problems of factorization.
- ii) To find the causes of errors made by students in solving problem of factorization.

### **Significance of the study**

The purpose of this inquiry is to identify and classify by the relative frequency of the most common error made by a sample of pupils in their attempts to solve the problem of algebra .Algebra is an useful and important topic from where no one can escape ,but it help to find out what error were committed by the learner ? Why were they feeling difficulty? And what are the ways to make it simple while teaching? Remembering these facts as central point's the researcher analyzed the error committed by grade IX students in algebra. Besides that several variation influencing students learning and achievement in mathematics errors committed by the students in solving the problem of factorizations are categorize on the basis of research and it would be immensely beneficial for.

1. It would help teacher to organize his experience and teaching strategies and adopt suitable method to teach.
2. It would help the educators Mathematics teacher, Policy maker, Mathematics educationist, curriculum planner and students to organize the learning experience in the appropriate manner.
3. To know the errors committed by the students and to choose the best way of minimizing it objectives of the study.

4. This study would be significant for the students of mathematics to minimize their errors.

### **Delimitation of the Study**

Single research or study cannot cover the whole the area of the study or cannot be generalized in all contexts. So this study would be delimited under the following aspects

- i) This study would be delimited in Kathmandu District.
- ii) This study would be limited only in solving the problem of factorization in algebra of school Mathematics
- iii) The sample of the school would be taken according to researcher convenience.
- iv) Some the variables like age level of students, classroom environment ,rank of the students , socio-economic status of student were ignored.

### **Definition of terms related to error.**

**Error:** All learners make error. Generally, an error means a simple lapse of care or concentration which almost everyone makes at least occasionally. In mathematics, an error means the deviation from a correct solution of a problem or the mistake which occur regularly in the form of learner activities.

**Reading error:** An error defined as reading error if the students has not been able to read all the words in the questions such that s/he can't grasp all the information given in the question.

**Carelessness error :**An error as classified as carelessness if the students commit errors in written test or worked out the solution but corrects the errors himself while interviewed.

**Comprehension error:** Students has not grasped the overall meaning of the words and therefore not proceed along an appropriate problem solving path.

**Motivation error:** If the students decline to proceed further due to psychological reasons.

**Transformation error:** An error was classified as transformation error if the students had understood what the question was asking about but unable to identify the correct operation or sequence of operation needed to solve the problems.

**Process Skill error:** An error was classified as process skill error when a student able to identify the correct operation but didn't know the procedure to carry out these operation correctly.

**Encoding error:** An error was classified as encoding if the students correctly worked out the solution to the problem but couldn't express the solution in an acceptable written form.

**Misconceptions:** Student beliefs their theories, meanings, and explanations will form the basis of the term student conceptions. When those conceptions are deemed to be in conflict with the accepted meanings in mathematics, then a misconception has occurred (Osborne & Wittrock, 1983)

## **Chapter -II**

### **Review of Related literature**

The review of related literature deals with the theories of research studies which have been conducted earlier. It helps to conduct the new research in systematic manner by providing the outline of the research study. There are two types of literature which are empirical and theoretical. The empirical literature includes the different researches in the problem face by the learning mathematics and theoretical for the understanding of learning. Mainly the literature included previous thesis, book journals and internet.

The major purpose of the present study was to find out the pattern of errors made by the student while learning algebra in grade IX different related literature would be helpful in understanding different aspect of error analysis of algebra.

#### **Empirical Literature**

The researcher has tried to find out the literature relate to identification and analysis of errors committed by the students some of them are below:

Bhatt (2003) studied on "An Error analysis in quadratic equation at grade X". This study was mainly focused with identification and comparison of errors committed by grade X students in Quadratic equation. The main objective of this study was to find the errors of grade X students in understanding, knowledge of solving and application of Quadratic equation. Furthermore it helps to study the error in the topic of quadratic equation with respect to, "Gender" location of the schools and "Types of schools. While observing researcher found that Students committed more error in knowledge than understanding of quadratic equation, Students generally committed more errors in application of quadratic equation than understanding of quadratic equation and Students committed more errors in formulation rather than solving the quadratic equation etc.

Panta (2005) studied on computational error of Grade VI students on operation of fraction on chitwan district. The main finding of this study was to find the more error in introduction of fraction than in addition or subtraction of fraction, students

commit more errors in subtraction than in addition of fraction and there is no effect of sex to commit the errors on the operation of fraction consider in her study.

Upadhyaya (2007) studied on "The types of error mostly done by the students of class V in Janakpur Municipality. He found that Students did use primitive methods (addition operation) the mostly elementary method. So far of the higher concept (multiplications and division) in mathematics are concerned they did not come easily and Student was observed using their own method. Similarly he also found that students did use their methods but couldn't supply enough reason while putting down in examination paper and most of the student couldn't understand the situation given in language form.

Chand (2008) studied on "An error analysis of grade VI students in arithmetic". The main aim of this study was to identify of error committed by the students of grade VI in solving verbal problem of arithmetic .This study also intended to accomplish the following objectives – to compare the occurrence of error in solving verbal problems gender wise, to investigate the causes of error and to identify the indigenous method of solving verbal problems by children .He found that where total number of error committed by the students were 216. Out of these error 109 were committed by boys and 107 were committed by girls .Among them 6% of total errors were concentrated in reading level, 34% errors were concentrated in comprehension level, 32.9% errors were concentrated in transformation level, 14.8% error were in process skill level, 3.7% errors were encoding error 2.8% were motivation error, 5.1% error were carelessness error.

Khatiwada (2013) studied on "An error analysis in fraction of grade V students". The main aim of this study was to identify of error committed by the students of grade five in solving problem of fraction in arithmetic and algebra .This study intended to accomplish the following objectives – to find the error made by students in solving the problem related to fraction, to compare the occurrence of error in solving problems of fraction in arithmetic and algebra, to investigate the causes of error and to identify of the indigenous method of solving problems of fraction by children .She found that where the study shows that 49.11% errors in arithmetic in solving the problem of fraction of committed by twenty students where 16.08% errors occurred at the comprehension stage,12.50% errors occurred at the transformation



stage,9.82% errors occurred at the process skill stage,6.25% errors occurred at the encoding stage,4.46% errors occurred at the carelessness stage.

Similarly, the study shows that 50.89% errors in algebra in solving the problem of function of committed by twenty students where 12.52% errors occurred at the comprehension stage,15.21% errors occurred at the transformation stage,9.54% errors occurred at the process skill stage,8.14% errors occurred at the encoding stage and 5.49% errors occurred at the carelessness stage.

A short review of literature showed that the investigation could not reach the proper level of analyzing the errors the topic in which researcher is interested is unexplored to the Nepalese teacher expert. However, the researcher has tired himself to meet the stated objectives as for as possible.

### **Theoretical Review**

Newman (1977), An Australian language educator in the mid-1970's developed a systematic procedure for analyzing errors made by students responding to written mathematical task. Since 1977 a steady streams of research paper has been published reporting "Newman data" for Asia-pacific region Australia, Brunei Indonesia, India, Malaysia, the Philippines and Thailand. The study was placed on pencil and paper test.

According to Newman a person wishing to obtain a correct solution to word problems this must ultimately precede the following hierarchy.

- i) Read the problem
- ii) Comprehend what is read.
- iii) Carryout the mental transformation from the words of the question to the selection of an appropriate mathematical strategy.
- iv) Apply the process skills demanded by selected strategy and
- v) Encode the answer in an acceptable written from.

According to Clement (1980) errors due to the form to the questions is 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 question.

The distinction is presented beside the five stages hierarchy two other categories "carelessness" and "motivation" have also shown as separate from hierarchy because as indicated such error can occur at state of the problem solving process. According to Newman's definition the error in this study was analyzed as,

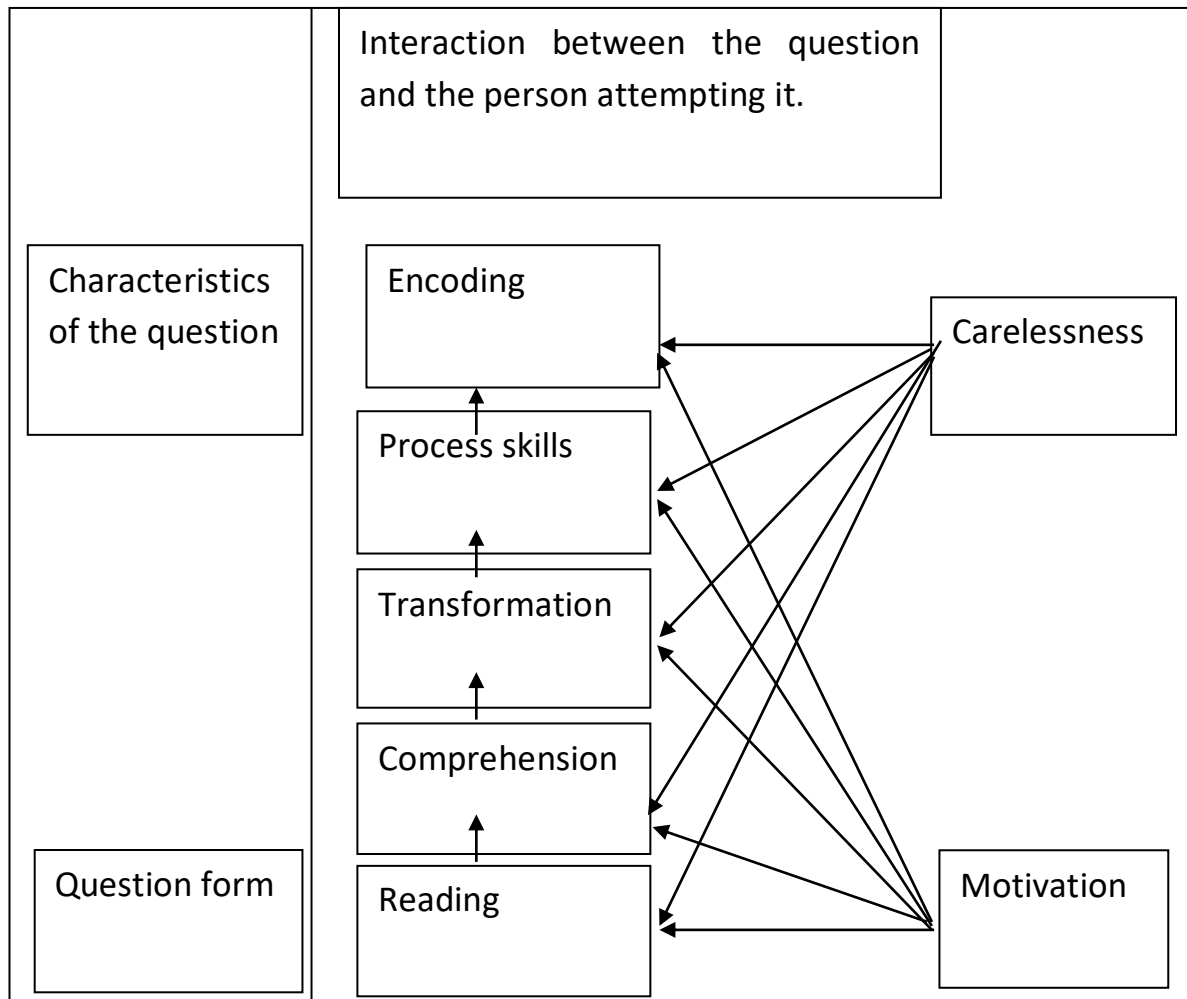
- i) Reading error.
- ii) Comprehension error.
- iii) Transformation error.
- iv) Process skill error
- v) Encoding error

Newman (1977) ,recommended that the following question or a request be used in interviews which are carried out in order to classify students errors on written mathematical tasks :

Classification	Typical Questions	Error
1. Reading	Please read the question to me (If you don't know a word or number, leave it out )	Don't recognize key words or symbols
2. Comprehension	a. (Point to a words or symbol) what does this words/symbol mean? b. Tell me that what the question is asking you to do?	Can read the problems well but cannot comprehend meaning of the word symbol or questions.
3. Transformation	Tell me how you start to find an answer to this question	Cannot transform sentences into mathematical forms.
4. Processing skill	Show me how you get the answer .Tell me what you are doing as you work	Can choose an appropriate operation but cannot complete the operation accurately
5. Encoding ability	Write down the answer to the question.	Can perform the correct operation but writes the answer incorrectly

Similarly according to Clements's definition the error in this study was analyzed as Carelessness error and Motivation error

Clements (1980), illustrated the Newman technique with the chart/diagram shown in figure given below:



Source : Clements's Definition of Error.

Thus the original error should be classified as a transformation error the students comprehended the questions but did not succeed in developing strategy.

### **The Conceptual Understand of the Study:**

The conceptual understanding is established on the basis of research topics .This study is related to error analysis of grade IX students in factorization, the difficulties would be drawing on the basis of environment of class, teaching methods. The main target of the studies to identify the types of difficulties and why the students made error in solving problems of factorization .The researcher use of the Newman theory of error analysis. The study would be design according to survey type .The

researcher collected the information on the basis of teaching method and materials ,students activates and content of factorization, from the conceptual frame work the researcher construct different tools such as written question, interview schedule and observation guideline for the students which are describe in chapter III .Moreover the classroom observation is the basis of the following main topic .Appearance in the classroom, initiation of chapter, subject matter sequences, instructional materials ,students participation, teaching activities ,classroom management and teaching method etc. Then the researcher compares all information with the information from Newman error theory to find the error in factorization of grade IX students.

## **Chapter-III**

### **METHOD AND PROCEDURE**

In this chapter, Research explain the main methodological constructs that is employing various stages of the study and later unite them together to create an overall summary of the methodology. This discussion includes a review of the methods that were used in different stages of the study and their validity and reliability, sampling procedures, the pilot study, main study, data collection instruments, data analysis methods. Research methodology is a scientific approach which deals with the systematic ways of collecting data and use to appropriate research design. It describes the design of procedure which is to be carried out to achieve the objectives of the study. These describe as follows.

#### **Design of Study**

The research design of the study would be small scale survey (quantitative method) followed by qualitative methods. This study would base on descriptive in nature. It is a descriptive because it aimed to describe the event or situation addressing the present activities of the students. The researcher would use the Newman's theory of error analysis as theoretical background and on the basis of them, result would be analyzed.

#### **Population of Study**

The population of the study would be taken all the students of secondary level of Kathmandu district in which all students belong to grade IX in academic year 2070/71 BS.

#### **Sample of the Study**

The sample of the study would be from Kathmandu district .There are one private school .The aim of taking this school as a sample where problem is arrive.

Among students of grade IX the research would be selected only 123 students to administrate a test and among them only 20 students would be taken purposively for in depth interview as sample.

## **Tools of Data Collection**

To get the reliable data the researcher developed an achievement test and individual interview schedule of each student on solving the problem of situation on factorization in algebra. The test would develop on the basis of Mathematics textbook of grade IX prescribed the Curriculum Development Center of Government of Nepal. The researcher also use the in depth interview schedules after the test to identify the errors so in this research, audio recording, written test, interview schedule were the main tools to collect the information for the study .

### **Written test**

Written test is widely used test to evaluate the students formally. Its helps to examine the knowledge of students acquired from the certain contents. Written test is more effective when interview and observation are not sufficient .Written is a set of question, which are made researcher from the related contented in which the students here to response it.

### **In depth Interview Schedule**

In depth Interview is two ways inter action between researchers and researched as in the form of interviewer interviewee. It is also kind of oral open questionnaire, which helps us to understand participations perception about the particular phenomenon. From which we can collect the data from other sources. Interview consists to the students about their education and family background and their experience opinions, feeling and knowledge, In this research the researcher used the in depth interview schedules.

### **Data Collection Procedure**

To fulfill the objectives of the study related data would be gathered. For this researcher consists of many kinds procedure of getting data and information. During the researches time, at first the researcher would visit the sample school and consult with sample students. The test be would administered to sample students of grade IX. The test would be taken in suitable environment, the test meant to written by 123 students who participated in this study and after checking the answer sheet, the

researcher would take only 20 students for in depth interview among the sample students who repeated maximum error, so as to take qualitative data in details according as interview guideline. The researcher would classify the student's response on written mathematical tasks as reading error, comprehension error, transformation error, process skill error, encoding error and carelessness error.

### **Data Analysis Procedure**

The error would be identify as reading error, if the students did not able to read all terms in the question such that s/he cannot grasps all the information given in the question .The error would be identify as comprehension error if the students did not able to read all the words in question but did not grasps the overall meaning of the of the question and there is not proceed along an appropriate problems solving path .The error will be identify as transformation error if the students did not understand what the question was asking about but unable to identify the operation or sequences of operation needed to solve problems .An error would be identify as process skill error ,if the students made the mathematical expression but could not identify the operation and did not know the procedure to carry out this operation and did not know the procedure to carry out this operation correctly .The error would be identify as encoding if students correctly worked out the solution to the problems but not express the solution in an acceptable written form.

Furthermore, the collected information would be categorized in terms of category of respondents such as data from test in depth interview would be conducted with students have committed maximum errors. The crux of the interview would check out whether they were doing error. On the other aspect in to back out how and why did they commit such error?

To analysis the qualitative data of the study descriptive methods is used and for quantitative data statistical tools such as mean, percentage used. These data were presented in table and the result was analyzed.



## Chapter IV

### ANALYSIS OF DATA AND INTERPRETATION OF THE RESULT

This is a describe research related to the error made by students in solving factorization or verbal problems of algebra. The objectives of this study were to find the types of error committed by grade IX students in solving problems of factorization and to analyze the errors made by students in solving problem of factorization.

During this research sample were selected from class IX, sampling process done .With the help of different tools data were collected and reliability and validity of sample tested. Thus the obtained data were analyzed and interpreted under the flowing heading.

- Frequency and Distribution of errors,
- Identification of error,
- Reading error,
- Comprehension error,
- Transformation error,
- Processing skill error,
- Encoding error,
- Carelessness error,
- Motivation error.

As a first step, frequency of error for each conceptual area was calculated and then percentage number of error response for each type of error under each conceptual area was calculated. The table represents this information is given below:

**Table no. 1**

**Frequency and Distribution of Error According to Newman**

Name of errors	Comprehe nsion	Transforma tion	Process Skill	Encoding	Careless- ness	Total
Errors Times	133 times	37 times	111 times	41 times	15 times	337 times
Errors %	39.47 %	10.98 %	32.98 %	12.17 %	4.40 %	100%

Table no 01. show that the lowest no of times of error was concentrated in reading error, where as highest no of error was concentrated on comprehension error .This indicates that students commit less error while reading question, they always try to comprehend and do the problem but they could not comprehend. Also if the students were able to express the problem in mathematical term they cannot able to use proper procedure to solve the problem.

There were 4.40 % carelessness error, this error was due to carelessness by own students behavior. 10.98 % error were found transformation error and this indicate some of them were unable to do appropriate mathematical expression.12.17 % error were found encoding error .This error was due to the carelessness of students. 32.98 % error were found process skill error, this was the second highest percent of error. This indicates that if the students were able to express the problem in mathematical term they were not able to use appropriate procedure to solve the problem.39.47 % error were found comprehension error. This indicates that most of students were unable to comprehend the problem if comprehend they could not make the appropriate mathematical expression. Mostly comprehension error and process skill error were found most troublesome steps in solving verbal problems of algebra.

**Identification of Errors**

The Newman Procedure is a method that analyzes errors in sentence problems. In the process of problem solving, there are many factors that support the students to arrive at a correct answer. Generally there are two kinds of obstacles that on sample students from arriving at correct answers:

(1) Problems in verbal fluency and conceptual understanding that correspond with level of simple reading and understanding meaning of problems, and  
(This stage includes reading error and comprehension error)

(2) Problems in mathematical processing that consists of transformation, process skills, and encoding answers.  
(This error includes other errors except reading and comprehension error)

This classification implies that the students have to interpret the meaning of the question in mathematical context before they proceed to mathematical processing to obtain appropriate answer.

The first research question of the study was administered to a sample student of grade IX of selected school. Some errors done by students are listed below.

### **Reading error**

An error is defined as reading error if the students do not recognize key words or symbols on the question. Reading error was not found. All students managed to read the question easily because symbols are familiar and words are common in our daily mathematics activates.

### **Comprehension error**

An error would be classified as comprehension error if the students can read the problems well but it cannot comprehend the meaning of the words symbols or question. In other word a student had not grasped the overall meaning of the words and therefore was not proceed along an appropriate problem solving path. Comprehension error is related with the student's inability to get the idea that the question asks to solve and its process. It is related to the mind make up of the student. The example of this error may seem to be of transformation error because in this error student's error cannot be found until the question is transformed into solvable mathematical form. However, this error also can be found by verbal question answer with the student about what question is asking and how the student will solve the question.

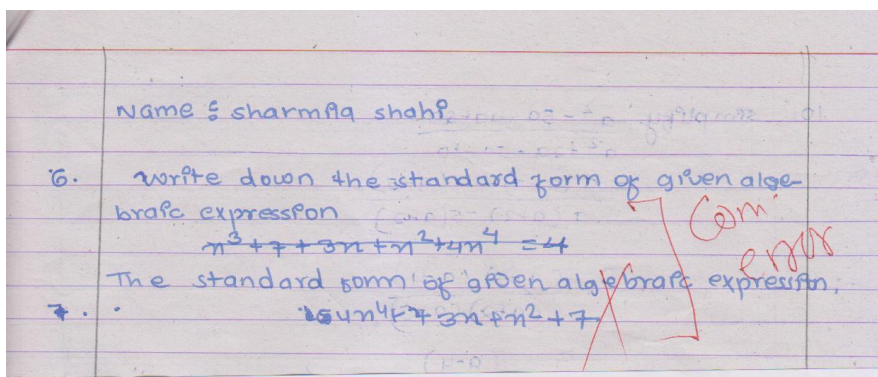
Some of the comprehension errors committed by the students are

Illustrated below:

Q. No. 06 Write down the standard form the given algebraic expression

$$4x^4 + x^2 + 3x - x^3 + 7$$

Sharmila had solved above question in the following way.



After the student had read the question correctly to the interview, the following dialogue took Place. ( I: interviewer; S student)

I: What is the question asking you to do?

S: It's asking about arranging of the terms in ascending or descending order according to its coefficient and power.

I: All right it is by coefficient or power?

S: Not sir, by both coefficient and power.

I: Ok, then write your answer

S:  $4x^4 + x^2 + 3x - x^3 + 7$

The interview continued beyond this point but it was clear what had been said that the original error should be classified as comprehension error because the student had been able to read all the words in the question but had not grasp the actual meaning of words standard form.

Then the interviewer suggests her is actual meaning of standard form of the algebra expression.

Oh, I was wrong .Now it is as like;

$$4x^4 - x^3 + x^2 + 3x + 7$$

And thank u sir now I understood.

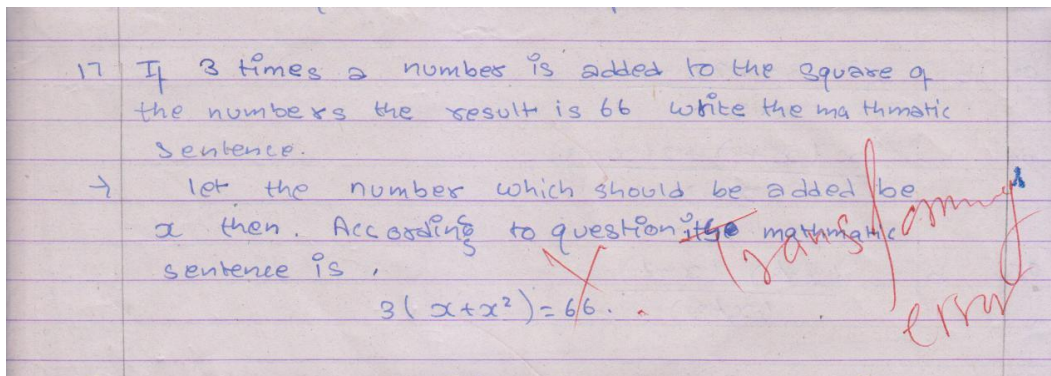
### Transformation error

An error is classified on transformation error if the students had understood what the question was asking about but unable to identify the question sequence of operation needed to solve problem. In other word, the students have understood the problem-but can't transform sentences into mathematical form.

Two examples of the transformation errors committed by the students are illustrated below:

Q.No 17, if 3 times of a number is added to the square of the numbers the result is 66, write the mathematics Sentence.

Neha had solved above question in the following way;



After the student had read the question correctly to the interview, the following dialogue took place. (I: interviewer, S: Student)

I: Which is the question asked for you to do?

S: It's... 3 times a number is added to the square of the number the result is 66.

I: All right how did you work at that?

S: First added a number with square of that and then multiply by 3 and result will be 66.

I: Now write down this problem into mathematical form

S:  $3(x + x^2) = 66$

The interview continued beyond this point but it was clear what had been said that the original error should be classified as transformation error because the student has understood what the question was asking about but she had done mistakenly so she did not succeed. The interview commented about her correctness on the question without making know her, her place of error.

I: You are wrong Neha now read carefully and find what is the question asking you to do?

S: It's asking...

I: All right: How did you worked that out ?

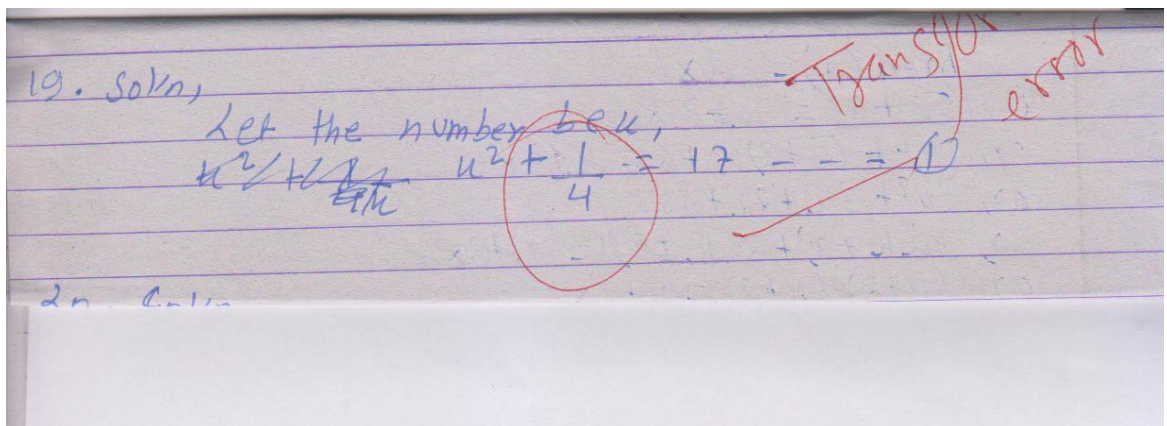
S: First let a number and multiply it by 3 and add with square of then the result will be 66.

I: Now, write down this problem into mathematical form

S:  $3x+x^2 = 66$

Then she proceeded on the solution of the question.

Q.No.9 The Square of a positive number added to one fourth of it is equal to 17. Shiwani had solved above question in the following way: write mathematics sentence.



After the student had read the question correctly to the interview, the following dialogue took place. (I: Interview; S: Student)

I: What is the question asking you to do?

S: It's...about the mathematics sentence of the sum equal to 17

All right.

I: Now write down this problem into mathematical form.

$$x^2 + \frac{1}{4} = 17$$

The interview continued beyond this point but it was clear what had been said that the original error should be classified as transformation error because the student has understood what the question was asking about she had converted mistakenly. So that didn't succeed in developing an appropriate strategy.

At his solution, the interviewer asked Shiwani to find out her error in her solution, and then she read his solution and pointed out her error by saying the words:

"Oh Sir, I found it, it is in the final answer..."

### Process skill error

An error was classified process skill error when the students able to identify the error operation but did not know the procedure to carry out this operation correctly. If students can choose an appropriate operation but cannot complete the operation correctly.

Some of the process skill errors committed by the students are illustrated below:

Factorization;  $x^3 + 3x^2y + 3xy^2 + y^3 - z^3$

Simran had solved this problem as follows:

25. Solution:

$$\begin{aligned} & x^3 + 3x^2y + 3xy^2 + y^3 - z^3 \\ &= (x+y)^3 - (z)^3 \\ &= (x+y-z)(x+y)^2 + (x+y)z + (z)^2 \\ &= (x+y-z)(x^2+2xy+y^2) + (x+y)z + z^2 \\ &= (x+y-z)(x^2+2xy+y^2) + (x+y)z - z^3 \\ &= (x+y-z)(x^2+2xy+y^2) + z(x+y+z) \\ &= (x+y+z)(x+y-z)(x^2+2xy+y^2) \end{aligned}$$

*Skill error*

After the students had read the question correctly to the interviewer, the following dialogue took place.( I: Interviewer, S: Student)

I : What is the question asking you do to do?

S: It's factorization  $x^3 + 3x^2y + 3xy^2 + y^3 - z^3$

I : All right, How did you work out that?

I: Show me how you can use to find an answer to the question explained to me what you are doing as you do it?

$$\begin{aligned} \text{S:} \quad &= x^3 + 3x^2y + 3xy^2 + y^3 - z^3 \\ &= (x + y)^3 - z^3 \\ &= (x + y - z) (x + y)^2 + (x + y)z + z^2 \\ &= (x + y - z) (x^2 + 2xy + y^2) + (xz + yz) + z^2 \\ &= (x + y - z) (x^2 + (2xy + y^2) + z(x + y) + z^2 \\ &= z(x + y + z) (x + y - z) (x^2 + 2xy + y^2) \qquad \text{Error} \end{aligned}$$

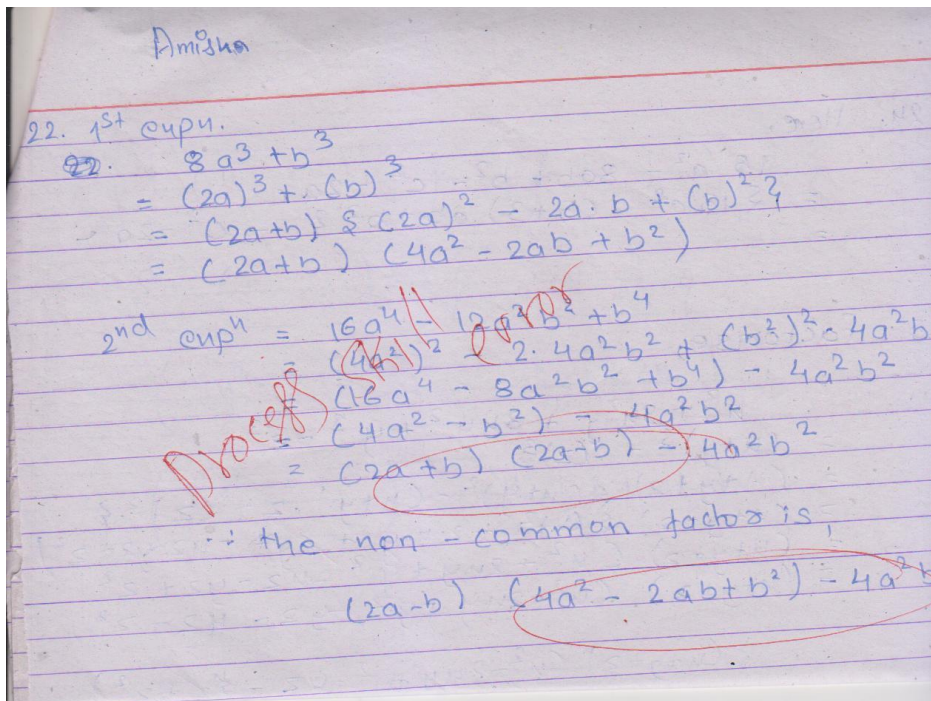
The interview continued beyond this point but it clear what had said that the original error should be classified as process skill error because the student had been able to identify the correct operation but she did not know the procedure to carry out this operation correctly. When the interview asked Simran to solve the question again; surprisingly she told that: "Sir, I had remembered the question and tried to check whether I was right or not...I found my error in the last of my answer..."

Then she completed her answer by the right process.

Q. No. 22 Find non common factor if  $(8a^3 + b^3)$  and  $16a^4 + 12a^2b^2 + b^4$

Amisha had solved this problem as follows;





After the students had read the question correctly to the interviewer, the following dialogue took place. (I: Interviewer; S: Student)

I: What is the question asking you to do?

S: It's ... For non common factor of given expression

I: All right. How did you work that out?

S: First, finding the factors of expression.

I: Show me how you can use to find an answer to the question explained to you are doing as you do it?

S:  $8a^3 + b^3 = (2a)^3 + (b)^3$

$$= (2a+b)(4a^2 - 2ab + b^2)$$

and,  $= 16a^4 - 12a^2b^2 + b^4$

$$= (4a^2)^2 + (b^2)^2 - 8a^2b^2 - 4a^2b^2$$

$$= (4a^2)^2 - 8a^2b^2 + (b^2)^2 - a^2b^2 - 4a^2b^2$$

$$= (4a^2 - b^2) - 4a^2b^2$$

$$= (2a + b)(2a - b) - 4a^2b^2 \quad (\text{error})$$

∴ The non common factor is

$$(2a - b)(4a^2 - 2ab + b^2) - 4a^2b^2 \quad \text{Errors}$$

The interview continued beyond this point but it was clear what had been said that the original error should be classified as process skill error because the student had been able to identify the correct operation but she didn't know the procedure to carry out this operation correctly.

To show her error in the process of solution made by her the interviewer asked Amisha to find out the same. She started to figure out but she could not. Then the interviewer showed error and explained about it.

I: You have made the error in this time. You can not eliminate the bracket because it has been in the process from earlier, and at last, again you will use formula. Like as earlier.

S: Ok, thank you Sir I understood now.

### **Encoding error**

An error was classified as encoding error if the student correctly worked out the solution to the problems but express the solution in an acceptable written form. In other word, the student can perform the correct operation but write the answer incorrectly.

Sum of the encoding errors committed by the students are illustrated below.

Q.No.  $(x - y)(x + y)(x^2 - y^2)(x^4 + y^4)$

Kirstina had solved the problem in the following way:

9. Simplify.

$$(n-y)(n+y)(n^2+y^2)(n^4+y^4)$$

$$= (n^2-y^2)(n^2+y^2)(n^4+y^4)$$

$$= (n^2)^2 - (y^2)^2 (n^4+y^4)$$

$$= (n^4-y^4)(n^4+y^4)$$

$$= (n^4)^2 - (y^4)^2$$

$$= n^6 - y^6 \rightarrow$$

Encoding

After the students had read the question correctly to the interviews, the following dialogue took place. (I: Interviewer, S: Student)

I: What is the question asked you to do?

S: It's simply  $(x-y)(x+y)(x^2-y^2)(x^4+y^4)$

I: All right. How did you work out that?

I: Show me how can you use to find an answer to the question explained to me what you are doing as you do it?

$$= (x^2 - y^2)(x^2 + y^2)(x^4 + y^4)$$

$$= (x^4 - y^4)(x^4 + y^4)$$

$$= (x^4)^2 - (y^4)^2$$

$$= x^6 - y^6$$

The interview continued beyond this point but it was clear what had been said that the original error should be classified as encoding error because the student had

worked out the solution correctly to the problem but she couldn't express the solution in an acceptable written form.

The interviewer realizes about the error committed by the Kristina make the solution again of this problem, you have made mistake while solving it before.

S: Ok sir

(She solved the problem as she had done before)

I: Kristina, you have made the mistake in the end of your solution, can you figure out it?

S: Oh, yes sir, I found it, I found it and thank u sir now I understood.

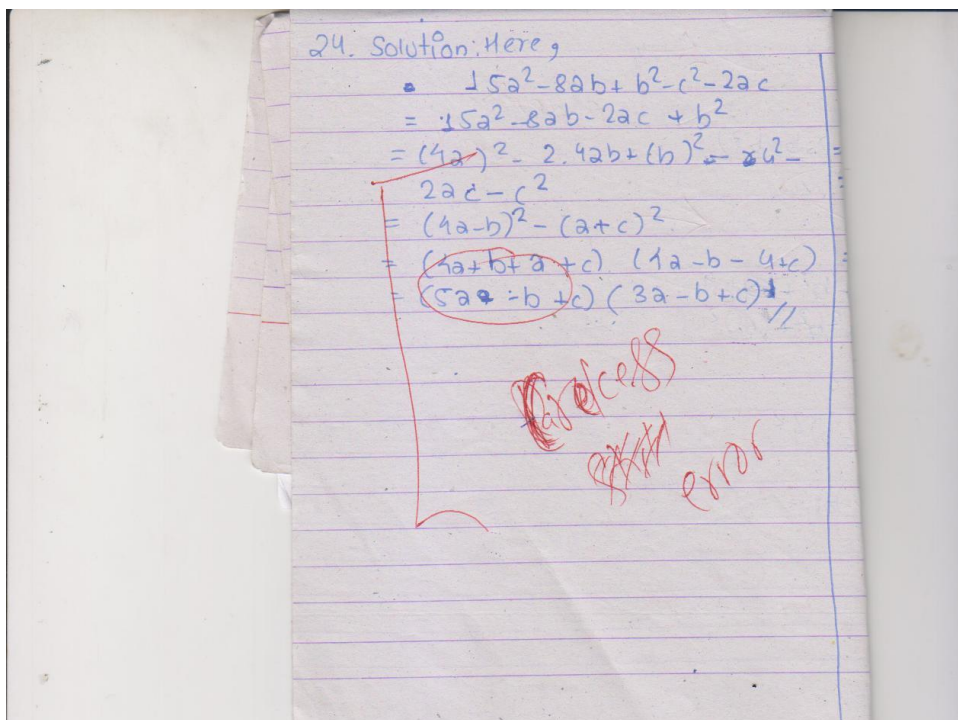
### Carelessness error

An error was classified as carelessness error if the students worked out the solution to the problem by doing mistake in calculation process.

Some of the Carelessness error committed by the students is illustrated below:

Q.no.  $15a^2 - 8ab + b^2 - c^2 - 2ac$

Bikalap had solved above question in the following way:



After the students had read the question correctly to the interviewer, the following dialogue took place,( I: Interviewer; S: Student)

I: What is the question asked for you to do?

S: It's.... factorization of multinomial

I: All right, how did you work out that?

$$=15a^2 - 8ab + b^2 - c^2 - 2ac$$

$$= (4a)^2 - 2 \cdot 4a \cdot b + b^2 - a^2 - 2ac - c^2$$

$$= (4a-b)^2 - (a+c)^2$$

$$= (4a + b + a + c)\{4a - b - (a + c)\}$$

$$= (5a - b + c)(3a - b - c)$$

S:  $(5a - b + c)(3a - b - c)$

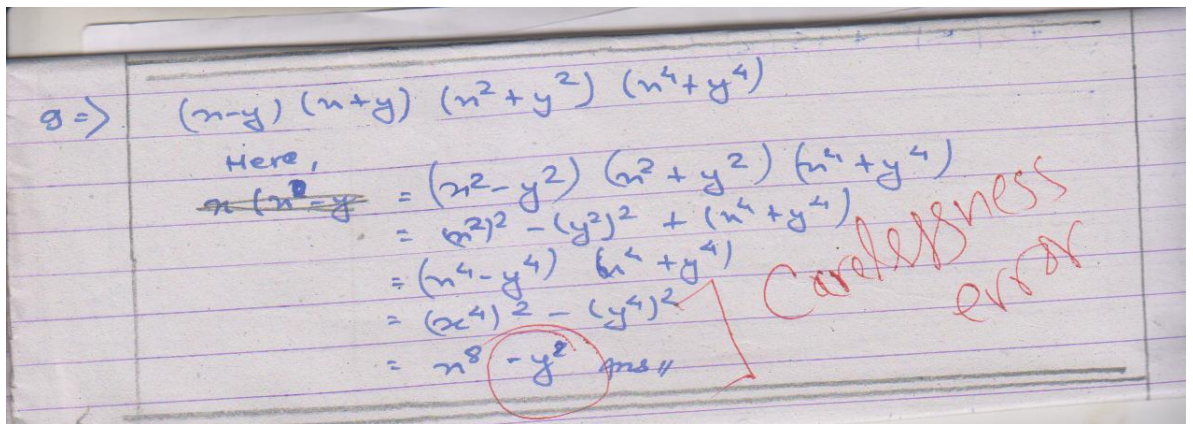
The interview continued beyond this point it was clear what had said that the original error should be classified as carelessness error because the student had been doing mistakes due to simple careless.

Bikalap realized mistake after the interview asked to solve the question again. He completed the solution without any mistake and he saw his original answer sheet and spoke the words:

"I will care my process in future, not a big mistake but it will reduce my marks in my exam. I will get my skills developed.

Q.No. 6  $(x - y)(x + y)(x^2 + y^2)(x^4 + y^4)$

Sujan had above question in the following way:



After the student had read the question correctly to the interviewer, the following dialogue took place. ( I: Interviewer; S: Student)

I: What is the question asked for you to do?

S: It's asking..... simplify of  $(x-y)(x+y)(x^2+y^2)(x^4+y^4)$

I: All right how did you work that out that?

S:  $(x^2 - y^2)(x^2 + y^2)(x^4 + y^4) = (x^4 - y^4)(x^4 + y^4)$

$$= (x^4)^2 - (y^4)^2$$

$$= x^8 - y^2 \quad \text{Error}$$

The interview continued beyond the point but it was clear what had been said that the original error should be classified as carelessness error because the student had been doing mistake due to server careless.

Sujan tried to solve the question again after the interviewer asked to do, this time he did the solution right. He ended the conversation by saying: Thank you sir for making me aware about my carelessness. I will be more sensitive on my study.

### Motivational Error

Early school failure can lead to a lack of self-confidence with subsequent detrimental effects on learning. Errors are seen as a basic and positive stage of the learning process. They are seen as a means to inquire into the nature of a subject. It is suggested that errors are a natural concomitant of students' attempts to integrate new material that they are taught with already established knowledge. Since erroneous



rules cannot be avoided in instruction, educators are encouraged to use them as useful diagnostic tools to determine the nature of children understands of a mathematics topic. The problems in diagnosis and remediation have been an important concern for both mathematics and special educators. As learning difficulties, in general, occur for a variety of reasons, similarly mathematics differences can occur in a variety of ways. Even if students commit errors their self-confidence should not be deteriorated. The study environment should be fair enough to encourage them to learn in right way. Motivation Error is additional error type apart from Newman.

The interviews were conducted for twenty students who made maximum error. In fact data obtained from the interviews, students either did not understand or had only partial understanding of the concept and skills which the questions were testing when Newman interviews were conducted, it was found that 39.47 % errors occurred at the comprehension stage, 32.98 % errors occurred at the process skill stage, 12.17 % errors first at encoding stage, 10.98 % errors occurred at the transformation stage, 4.40 % errors occurred at the carelessness stage and reading error was not found.

### **Main Reason of the Error**

Out of five error types which were analyzed during our study comprehension error was found to be the major type of error. It was found that 39.47 % students make error in comprehension stage which is the first stage. Comprehension error means if a student had not grasped the overall meaning of the words and therefore was not proceed along an appropriate problem solving path. Comprehension error is related with the student's inability to get the idea that the question asks to solve and its process. It is related to the mind make-up of the student. The reasons of students not being able to comprehend the overall meaning of the question may be lack of vocabulary power, error in reasoning power, low level thinking, etc.

## **Chapter V**

### **SUMMARY, FINDINGS, CONCLUSION AND RECOMMENDATIONS**

This chapter deals with the study “An error analysis in fraction of grade IX students”. This chapter is divided into three sections, summary with findings, conclusion, and recommendation.

#### **Summary and Findings**

The main purpose of this research was to find out error analysis of grade IX students in factorization and to find the causes of errors made by the students in solving of problem. A small scale surveys method was used as research method as well as questionnaire and interview was developed for the key instrument. All the students of grade Nine studying in Gyankunj Higher Secondary school, Kathmandu district in academic year 2071BS were population of the study. Among them only 123 students of grade IX were selected for the administrative test and only 20 students were taken purposively for in depth interview as a sample. The title of the paper is “*An error analysis of grade IX students in factorization*”.

This study was conducted using small sample. The objectives of the study were to find the errors made by students in solving the problem related to factorization and to find the causes of errors made by the students in solving the problem of factorization related of algebra. So in this study, after analyzing responses and considering the different error patterns generated by different questions of factorization in algebra the following findings were drawn:

It was found that (39.47 %) errors occurred at the comprehension stage, (10.98%) errors occurred at the transformation stage, (32.98%) errors occurred at the process skill stage, (12.17% ) errors occurred at the encoding stage, (4.40 %) errors occurred at the carelessness stage and reading error was not found in this study. And, two important questions that emerge from the findings of this study is the following: why and how students do maximum error in Comprehension error (39.47 %) and process skill error (32.98%) as whole sample students. On the basis of this study the results are summarized in the following points:



- The study shows that 39.47 % errors occurred at the comprehension stage.
- The study shows that 10.98 % errors occurred at the transformation stage.
- The study shows that 32.98 % errors occurred at the process skill stage.
- The study shows that 12.17 % errors occurred at the encoding stage.
- The study shows that 4.40 % errors occurred at the carelessness stage.

Above finding are occurred because of lack of knowledge while selecting suitable method for teaching. There was no use of proper teaching method and poor concept of algebraic knowledge, theories and ideas among the students were might be reasons. Beside this huge class size, heavily content, curriculums were also responsible for this error. Following the traditional method in teaching for new generation did not bind on study, missing use of teaching aid and technology. There was no practice of poor performance students to improve their study because of poor assessment and promotions practices.

### **Conclusion**

In conclusion, from the above finding of the study it is concluded that the most of students commits error in comprehension and process skill error with comparison to other in solving problems of factorization of school algebra. According to Newman (1977), that is reading, comprehension and transformation errors made 124 low achieving grade VI pupils accounted for 19%, 22% and 12% respectively of all errors made. In her papers almost half the errors made occurred before the application of process skill. The data related to process skill, Transformation and comprehension error found higher as compare to Newman papers .In similar way error in reading is negligible.

The main causes of the error are lack of knowledge while selecting suitable method for teaching. It is found that no use of suitable teaching method and poor concept of algebraic knowledge, theories and ideas among the students. Beside this huge class size, heavily content and curriculum are also responsible for this error. Following the traditional method in teaching for new generation do not bind on study, missing use of teaching aid and technology. It is no practice of poor performance students to improve their study because of poor assessment and promotions practices.

## **Implication and Recommendations**

On the basis of this study the recommendations are following points:

- Teachers of mathematics should be aware of the language they use in the classroom. They should use simple language and all mathematical concepts should be verbally explained in details with necessary illustration.
- The researcher should be use test and must identify the area of difficulty and use remedial teaching to avoid the errors and if any error found must be corrected in front of students.
- The teacher must use new technology and teaching aids for algebra teaching in time to time and must be appear on the mathematics conference and seminar.

## **Suggestion for Further Study**

This research was conducted for only class IX for the short time. The following suggestions are for the further study:

- This study was confined only to the Kathmandu district. Therefore, further study should be done in the different district of Nepal
- More extensive researcher must be designed, and carried out in order to investigate the error analysis in algebra in large same and various school of different part of Nepal.
- It would be worthwhile to study the opinions and attitude of the teacher and students towards the attitude of the use of Newman approach with teaching model, etc.

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## Appendix I

### Class Test 2071 Gyankunj Higher Secondary School, Kathmandu Achievement Test

- This is a non-evaluative assessment. Your performance in this assessment will have to no bearing on your grades or evaluate in the course. The assessment is designed to help you with algebra, by helping your teacher understand the mistake you make, as well as why you make them.
  - Instructions
    - (a) Answer all questions
    - (b) Use algebraic method to solve all the problems
    - (c) Time:90 min
    - (d) If there is correct answer please choose correct one
1. The process of expressing a polynomial as the product of two or more polynomial is called .....
    - (a) factorization
    - (b) algebraic expression
    - (c) simplify
    - (d) L.C.M.
  2. Which one is the correct mathematics sentence if the square of the different of two quantities ie equal to sum of their square minus twice their product.
    - (a)  $(a + b)^2 = a^2 + b^2$
    - (b)  $(a - b)^2 = a^2 - 2ab + b^2$
    - (c)  $a^2 - b^2 = a^2 - b^2$
    - (d)  $(a - b)^2 - 2(a - b)$
  3. If  $(x + a)$  and  $(x - a)$  are the factors then what is the product form its?
    - (a)  $x^2 + a^2$
    - (b)  $x^2 - a^2$
    - (c)  $(x + a)^2$
    - (d)  $(x - a)^2$
  4. What do you mean by cube of Binomial?
    - (a)  $(a + b)^3$
    - (b)  $3a + 3b$
    - (c)  $a^3 + b^3$
    - (d)  $3a + b^3$
  5. What are the factors of  $(a + b)^3$  ?
    - (a)  $(a + b) (a + b) (a + b)$
    - (b)  $3(a + b)$
    - (c)  $a^2 - ab + b^2$
    - (d) None of them
  6. The area of a rectangle is  $(x^2 + 5x + 6)$  sq units. If the length of its one side is  $(x + 3)$  units, then find its breadth?
  7. The product of two expressions is  $x^2 + 7x + 12$  and one of the expressions is  $(x + 4)$  find the other.
  8. Simplify,  
 $(x - y)(x + y)(x^2 + y^2)(x^4 + y^4)$

9. Write down the standard form of given algebraic expression  
 $x^3 + 7 + 3x + x^2 + 4x^4$
10. If 3 times a number is added to the square of the numbers the result write the mathematics sentence of it.
11. If one number is 5 less than another and their product is 36 then write its mathematics sentence.
12. The square of a positive number added to one fourth of it is equal to 17 then write its mathematics sentence.
13. One number is 6 more than another and their product of 36 then what is the mathematics sentence?
14. Find the common factor of  $x^2 - 4$  and  $x^2 + 2x + 4$ .
15. Factorise,  $15a^2 - 8ab + b^2 - c^2 - 2ac$
16. Factorise,  $ab^2 - b(a - c) - c$
17. Factorise,  $x^3 + 3x^2y + 3xy^2 + y^3 - z^3$
18. Write down the non common factor of  $8a^3 + b^3$  and  $16a^4 + 3a^2b^2 + b^4$
19. Which one of the factor of both  $x^2 - x - 6$  and  $x^2 - 5x + 6$  ?
20. For what real number  $x$  is  $x^2 - 6x + 9$  negative?
21. Show that  $(a^3 + b^3) = (a + b)^3 - 3ab(a + b)$
22. Factorise,  
 $6a^2b(x + y) - 15ab^2(x + y)$
23. What does  $yz$  means? Write your answer in words.
24. Simplify,  $\frac{a^2 - 5a - 4a + 20}{a^2 + 2a - 5a - 10}$
25. Resolve into factors.

$$7\left(x - \frac{1}{x}\right)^2 + 15\left(x - \frac{1}{x}\right) + 2$$

## Appendix-II

Name of student	RE	CE	TE	PSE	EE	CE	ME
Rakshya Kunwar		I					
Pradikshya Dawadi		I		III			
Nabin Luitel		I	I	I	I		
Swikriti Bhusal		I		III			
Manoj Sharma		I	I	I			
Sauav Aryal		I		I			
Sakar Gyawali		I		I			
Shyam Prakash Gupta							
Shrija Khanal		I		II			
Surasha Shrestha		I		II			
Bikalpa Pokhrel		I	I	I			
Abhilasha Subedi		II	I	III	I		
Arati Mishra		I		II			
Priiyanka Kc		I		II	I		
Rakshya Neupane		I	I	II	I		
Nejiya Joshi		I		III	I		
Shweta Karki		I		II	I		
Ashmita Magar		I		II			
Ritisha Ranjit		II			I		
Arina Bidari		I	I	II			
Raju Rai		I		I			
Aditi Khanal		-	-	-	-	I	
Sudin Shrestha		-	-	-	-	-	
Ankita Tripathi		II					
Amod Suman		I					
Namita Sharma					I		
Anish Belbase		I		I			
Shobha Pandey		I		I			
Ankit Pokhrel		I	I				
Pema lama		I	I				

Melani Sharma		I		I		I	
Zalzala Bhurtel		I		II			
Prachi Adhikari		I		I			
Preethaja Shah				I			
Sanjiv Surgabankhi		I		I			
Sundesh Shrestha		I					
Nasir Uddin		I	I				
Saugyan Chapain		I					
Niraj Kc		-	-	-	-	-	
Bishal Thapa		I	I	I			
Sulav Regmi		I		II			
Dipesh Pun		II		I	I		
Hemanta Kc	I	I		I	I		
Abhishek Shrestha	I	I		I			
Bijay Budha	I	II	I		I		
Ashok Gaire		II	I	II		I	
Sujan Rokka		II				I	
Bijay Bhusal		II				I	
Dipesh Sitaula		II				I	
MahimaDangol		III			I		
Amisha Mishra		II			II		
Shiwani Regmi		III			II		
Jenny Basnet		III					
Sita Suryabansi		I			I		
Rohit Parajuli		I					
Lina Lamsal		I					
Manish Melaker		I				I	
Pratik Sapkota		I					
Anisha Giri		I					
Yunika Upadhaya		II					
Anupa Paudel		I					
Tanusha Rana		II					



Laise Bidari		II					
Pragati Dahal						I	
Anisha Shingh						I	
Bikalpa Joshi						II	
Sadikshya Bashyal		I					
Trisha Sharma		I					
Simran Subedi		I					
Sandhya Adhikari		I					
Sarmila Shahi		I					
Rupa Adhikari							
Neha Rijal							
Ishika Silwal		I					
Sona Tamang							
Piyash Pradhan		II					
Pratibha Risal		I					
Samrajya Rayamajhi		I					
Anish Maharjan		I					
Simraj Joshi	I	I	I	II	I		
Ashish Remi Magar		I					
Khsha Maharjan		I					
Aurha Poudel							
Sugal Aryal							
Nishant Shrestha		I	II		I		
Shard Pokhrel		I	I	II			
Saugat Dangol		I	I	II	I		
Bishnu Pandey		I		II			
Shahants Sharma		I		II			
Sujan Magar		I		I			
Dipesh Baral		I					
Subhamya Nepal		I		II			
Kushal Sharma		I	I	II			
Aman Jha				II			

Ujwal Karki		I		I			
Anish Pokhrel		I					
Pratik Neupane		I		I			
Miren Sharma		I		I			
Rajan Shrestha		I		I			
Sonal Maharjan		I					
Abishek Shrestha		I					
Abishek Magar		I		I			
Sumiksha Rana		I		I			
Nikesh Nepal		I		II			
Saura Shtestha			I	II			
Bibek Asharpati		I	I	I	I		
Sulav Karki		II			III		
Sarona Kapali		II		III	I		

**Abbreviation symbol of different kinds of errors made by students**

Comprehension Error = CE

Transformation Error = TE

Process Skill Error = PSE

Encoding Error = EE

Carelessness Error = CL

Reading Error = RE

Motivation Error =ME

### Appendix III

Letter to school principal

Dear \_\_\_\_\_,

I am a thesis year M.Ed. student in the Tribhuvan University. My thesis supervisor is Mr. Abatar Subedi .I am also an instructor of mathematics education for school students at Tribhuvan University. For the final thesis in my M.Ed program, I am hoping to conduct a research study which examines grade IX students' Difficulties in Algebra. I have selected your school to collect data for this study. The purpose of this study is to identify student difficulties in solving algebraic problems and to suggest some remedial measures to overcome these difficulties. In order to examine student errors, I wish to administer a test instrument to 121 students in classrooms. Later, 10 students will be selected for interviews based on their answers to the test. The test paper will take approximately one and half hour to answer and each interview will last within 10 to 15 minutes. Further, I hope to interview One mathematics teachers of those students to get their views on student errors. Each interview will be tape-recorded for later transcription. I would like to request the participation of your school in this study by allowing me to conduct the test and the interviews. The teachers will be given a summary of their interviews later. You will also be given an opportunity to receive a summary of the findings. I will not use teachers' or students' names or anything else that might identify them in the written work, oral presentations, or publications. The information remains confidential. They are free to change their minds at any time, and to withdraw even after they have consented to participate. They may decline to answer any specific questions. I will destroy the tape recording after the research has been presented and/or published. There are no known risks to you for assisting in this study. If you would like more information, please contact me at my school. Please contact me at your earliest convenience to discuss the work or to provide your consent to participate.

Thank you for your consideration.

Yours sincerely,

Gopal Chandra Bhandari

## Appendix IV

Parent/Guardian consent letter

Dear Parents or Guardians,

I am a thesis year M.Ed. student of the Tribhuvan University. My thesis supervisor is Mr. Abatar Subedi. I am also an instructor of mathematics education for school student. For the final thesis in my M.Ed program, I am hoping to conduct a research study which examines grade IX students' Difficulties in Algebra. I have selected your child's to collect data for this study .I would like to request the participation of your child in this study.

Please indicate on the attached form whether you permit your child to take part in this study. Your cooperation will be very much appreciated. If you have any questions or would like more information, please contact me by phone or if you have any questions about your child's rights as a participant in this study, please

Thank you for your consideration.

Yours sincerely,

Gopal Ch Bhandari

### Parent/Guardian Consent Form

I agree to allow my child \_\_\_\_\_ to participate

(Son/daughter's name)In the test :

In the interview: Parent's/Guardian's signature: \_\_\_\_\_

Date:\_\_\_\_\_