

**AN ERROR ANALYSIS IN SOLVING WORD PROBLEMS IN
ALGEBRA AT THE SECONDARY LEVEL**

**A
THESIS
BY
MILAN DAHAL**

**IN PARTIAL FULFILLMENT OF THE REQUIREMENT FOR
THE DEGREE OF MASTERS OF EDUCATION**

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

This is to certify that **Mr. Milan Dahal**, student of the academic year **2073/075** with campus Roll no. **33**, Exam Roll No: **7328401**, Thesis No. **1753** and T.U. Registration No: **9-2-1-298-2013** has completed his thesis under the supervision of Mr. **Krishna Prasad Bhatt** during the period prescribed by the rules and regulations of Tribhuvan University, Nepal. The thesis entitled **An error analysis in solving word problems in algebra at the secondary level** has been prepared based on the results of his investigation conducted during the period April 2022 to July 2022 under the Department of Mathematics Education, University Campus, Tribhuvan University, Kirtipur, Kathmandu. His thesis number is **1753**. I recommend and forward his thesis for evaluation as the partial requirements to award the Degree of Master of Education.

.....
Prof. Dr. Bed Raj Acharya

Head

Date:-

LETTER OF APPROVAL

This thesis entitled "**An error analysis in solving word problems in algebra at secondary level**" submitted by **Mr. Milan Dahal** in partial fulfillment of the requirement for the Master's Degree in Mathematics Education has been approved.

Vice-Voce Committee

Signatures

Prof. Dr. Bed Raj Acharya
(Chairman)

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(External Supervisor)

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Krishna Prashad Bhatt
(Supervisor)

Date:-

RECOMMENDATION FOR ACCEPTANCE

This is to certify that **Mr. Milan Dahal** has completed his M.Ed. thesis entitled "**An error analysis in solving word problems in algebra at secondary level**" under my supervision during the period prescribed by the rules and regulations of Tribhuvan University, Kirtipur, Kathmandu, Nepal. The study embodies the result of an investigation conducted during the period 2020-2021 under the Department of Mathematics Education, University Campus, Tribhuvan University, Kirtipur, and Kathmandu. I recommend and forward his thesis to the Department of Mathematics Education for the final viva-voice.

.....

Mr. Krishna Prashad Bhatt
Supervisor

Date:-

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DEDICATION

This work is heartily dedicated to my respected parents my respected teachers, friends, and all family members whose support, love, care, and sacrifices made me the person I am now.

DECLARATION

This thesis does not contain any other work which is offensive and beyond the copy-written norms. To the best of my knowledge and beliefs, this research is truly based on my effort and it does not match with any research that was published earlier in any institution. I take all the ethical and legal responsibility for submitting this thesis.

.....
Milan Dahal

Date:.....

ACKNOWLEDGEMENTS

First of all, I would like to express my heartiest thanks and very sincere gratitude to my respected teacher Mr. Krishna Kumar Bhatt, Department of mathematics Education, T.U. who provided fundamental ideas and techniques to carry out this research, as a researcher supervisor. Without his immense co-operation and regular encouragement, I would not have been able to present this dissertation in this form.

I am also extremely grateful to Department Head Prof. Dr. Bed Raj Acharya, Department of Mathematics Education, T.U., for his inspiration in preparing this thesis. I would also like to express my special thanks to all staff especially mathematics teacher Mr. JiwanPokhrel and all the students of related schools for helping me out in course of data collection for this research.

I would like to give hearty thanks to my dear friends NabinDevkota, SujanSapkota, RohitGhimire, and Ramjee B. Karki. I am also thankful to my colleagues for their cooperation and help in the completion of this work.

Finally, I am grateful to my family members for their inspiration and assistance throughout my study.

.....

Milan Dahal

ABSTRACT

This study is entitled “**An error analysis in solving word problems in algebra at secondary level**”. The main aims of the study were to identify the errors done by students in solving word problems in algebra of mathematics at the secondary level and to identify the leading factors that affect solving word problems in mathematics at the secondary level. Here the present study was concerned with error analysis. This is a quantitative and descriptive survey design research. The sample of this study consisted of 30 students of Bhanubhakta H.S.S and Gyanodaya H.S.S studying at grade X as well as SEE students and the principal for interview.

The paper pencil test paper was prepared with the help of an authentic book of grade X. After that, the test was administrated to the sample of students by the researcher himself. After the Newman procedure of interview was administrated in the selected sample and then a depth interview was taken to find out the causes of error.

The study revealed that students had committed several errors in solving the word problems in algebra. The study showed that the maximum error was committed in comprehension (30.7%) and the least was committed in Process skill error (15.3%). There were many factors such as, lack of basic conceptual knowledge in algebra, language problems, less practice in word problems, the attitude of students towards algebra, teacher's qualification and performance, lack of practice, mixed-up rules, etc were responsible causes of errors made.

ABBREVIATIONS

CDC	:	Curriculum Development center
Ce	:	Comprehension Error
Ee	:	Encoding Error
Pse	:	Process Skill Error
T.E	:	Transformation Error
T.U.	:	Tribhuvan University

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CHAPTER I

INTRODUCTION

This study is related to **error analysis in solving word problems in algebra at the secondary level**. This introductory part includes the background of the study, statement of the problem, the rationale of the study, objectives of the study, research questions, significance of the study, delimitations of the study, and definition of the key terms respectively.

Background of the Study

Mathematics plays a vital role in our everyday life and has become an indispensable factor in the progress of our present-day world. Counting starts from day one of the births of a person. Most students would like to know why they have to study various mathematical concepts. Much has been said in current education about the need for students to exercise critical thinking and efficient problem-solving ability. Vernooy (1997) stated: Word problems are part of the mathematics curriculum for a good reason: They illustrate the connection between mathematics and clear, critical thinking on any subject.

Education as a system can be called the brain of any society and it is the backbone of any system. In the traditional sense, education is in which instruction takes place between an instructor and students where all are physically present in the same classroom. But at present, it is the way of learning by social interaction. Traditional education refers to the mainstream educational environment not designated as an alternative. Whether in traditional or in modern eras, mathematics is the fundamental subject for all streams. Many students find their studies in mathematics to be difficult and unrewarding. There is a tendency for students to opt-out of studying mathematics as soon as possible. However, mathematics is usually seen to be important and holds a central place in the curricula in most countries. Mathematical ideas find application in numerous areas of life and many careers. Thus, negative attitudes among students may have important ramifications for career choices and contributions to wider society (Akhter, 2018).

Mathematics is an essential part of the school curriculum of Nepal. It has been shown as a compulsory subject at all levels of school education programs.

Mathematics is also included as an optional subject in secondary-level education.

Although, mathematics has given an important place in the curriculum of all levels of school education. Most of the students are weak in mathematics and hence it is felt that most of the students dislike mathematics and are afraid of it. The result of the S.E.E. examination shows that most of the failures were in mathematics. In the context of Nepal, People used to say that mathematics is the so hard subject; it can be studied and learned by only gifted children. Higher levels of mathematics can study and learn by a male than female, girls cannot study mathematics, mathematics as a male subject, etc. are the traditional and narrow thinking about mathematics. So, this type of conception in the context of Nepal makes mathematics a difficult subject. On the other hand, at every level of mathematics, most of the problems are written in verbal form. Because of misunderstanding the word problems, students could not able to solve the problems. So they feel mathematics is a very difficult subject.

Word problems emphasize the precise definitions of terms, the making of only those assertions which specifically apply to the issues or objects under discussion, and the application of careful reasoning in problem-solving. These are all vital skills in any intellectually challenging profession, in forming thoughtful judgments about political and educational issues, and in making personal decisions. (p. 5). Clement (1982) stated, "For generations, mathematics teachers have voiced concern about the inability of their students to solve any but the most routine verbal [or written-word] problems even though they seem to have mastered all the requisite computational skills and algorithmic processes".

Solving word problems is among the main difficulties in algebra for many secondary school students all over the world (see, for instance, Bush & Karp, 2013; Carpraro&Joffrion, 2006; MacGregor& Stacey, 1998; Van Amerom, 2003). Student difficulties with solving word problems were revealed in the Trends in International Mathematics and Science Study (TIMSS) in 2007; for instance, the least percent (8%) of the participants were able to solve the word problem. This result was significantly below the international average of 18 percent (Mullis et al., 2008).

A common view among most researchers, mathematics teachers, students, and parents is that doing mathematics is considered the heart of mathematics (Cankoy&Ozder 2011, Cockcroft 1982, Kaur 1997, NCTM 2000, Schoenfeld 1985). An important component of mathematics training is solving a word problem. Real-world problems that require mathematics for solution typically do not come to us as equations ready to be solved but rather as a word or pictorial representation that must be interpreted symbolically, manipulated, and solved. It is for this reason that word problems are introduced in the earliest stages of mathematics instruction (Cummins, 1991). Verschafel et al. (2000) defined word problems as verbal descriptions of problem situations wherein one or more questions are raised, the answer to which can be obtained by the application of mathematical operations to numerical data available in problem statements.

Many factors contribute to word problems. In several studies, it has been shown that word problems become easier when they are embedded in a familiar context (De Corte et al, 1985, Davies-Dorsey 1991). The familiar contexts may cause children to pay more attention and it is easier to remember a familiar situation than an unfamiliar one (Stern and Lehrndorfer, 1992). The sources of difficulties in mathematics may be defined in terms of output difficulties, organizational difficulties, language difficulties, attention difficulties, visual-spatial difficulties or ordering difficulties, difficulties in multiple tasks, and difficulties in cognitive processes. However, these learning difficulties in mathematics refers to those outputs in mathematics problem data related to recalling basic mathematics fact, procedures, rules, formula, retrieving fact or pursuing procedure difficulty in mathematics practicing during mathematical work, and to difficulties in remembering previously encountered patterns to convert verbal problems in mathematics way and difficult in inert-relation between content and principle (Lagne, 2009). This study will study the difficulties of students while solving word problems in algebra.

Statement of the problem

A problem is the interrogative sentences or statements that ask what relation exists between two or more variables. The researcher tries to state the statement of problems related to this study. Nepal is committed to providing basic education to all groups of Nepal. But due to different kinds of problems like methodology,

instructional materials, environment, etc. mathematics subjects become more difficult for the students and there is less interest in mathematics, it becomes a phobia for the students. There is a lot of investment from the Nepal government to provide basic education to all.

In the achievement of students in mathematics, many factors influence directly. Although the influence of different factors in solving math word problems has been studied, until now, not any research has been done to examine teachers' viewpoints on student errors in solving word problems in algebra at the basic level. So based on the reviewed pieces of literature, the purpose of this study will be to identify what teachers reported as their students' errors in solving math word problems and the causes of those errors. This study also will investigate teachers' perspectives on why the ability to solve word problems is important for their students and what classroom practices and specific strategies they use in their attempts to foster student problem-solving success.

Research Objectives

It is the main destination of the study. They set out what we hope to achieve at the end of the project and are taken as objectives of the study. Objectives are basic tools that underline all planning and strategic activities. The following will be the main objectives of the study:

1. To identify the errors done by students in solving word problems in algebra of mathematics at the secondary level.
2. To identify the leading factors that affect solving word problems of mathematics at the secondary level.

Research Questions

It is the set of questions that indicates the direction of inquiry in research. It is a fundamental core of a study. So, to complete this study, it will be taken the following question as research questions:

1. What are the errors of students in solving word problems in mathematics at the secondary level?
2. What are the remedial measures to reduce errors in word problems of mathematics for the students at the secondary level?

Justification of the Study

Mathematics is a fundamental part of human thought and logic, and integral to attempts at understanding the world and ourselves. Mathematics provides an effective way of building mental discipline and encourages logical reasoning and mental rigor. In addition, mathematical knowledge plays a crucial role in understanding the contents of other school subjects such as science, social studies, and even music and art. In contemporary education, mathematics education is the practice of teaching and learning mathematics, along with the associated scholarly research. Mathematics has got a prominent place in the school curriculum for its practical value. It has been taken as a compulsory subject at the school level and elective discipline at the higher level. It is used in every discipline of study. So, its significance has been increasing day by day.

In this research, the learning difficulties being faced by the students and teachers in solving word problems will be the main focus of the study. Therefore, this study will provide some logical and valuable information about the current problem of learning difficulties in word problems at the basic level with the following significance.

This study will be helpful to identify the knowledge, skill, and application level of students in word problems of mathematics at the secondary level.

This study will be helpful to identify the errors of students in word problems in mathematics.

This study will be helpful to find and solve errors of students in solving word problems in mathematics.

It will be useful to make inclusive classroom teaching.

This study set up the implementation of the mathematics curriculum in the present context and may be ground for the further research on this issue.

This will be useful for parents, teachers and students, and other stakeholders for conducting related programs in the future for improving on teaching and learning strategy of learning word problems.

It will help students to minimize the error in solving word problems in mathematics.

Delimitations of the Study

The research will be related to learning difficulties in solving word problems of students at the basic level. The delimitation of this study is as follows:

The research will be delimited to Bhanubhakta H.S.S and Gyanodaya H.S.S schools in the Ilam district.

This study will include only class X students from selected schools, so the finding will not be generalized elsewhere.

The primary data for the research will be collected by achievement test, questionnaire, semi-structure interview schedule, and observations.

Only government schools will be included in this study.

This study will be limited only to the verbal problems of mathematics.

Operational Definition of Key Terms

Comprehension error. In this study, if a student cannot grasp the overall meaning of the given problem, these types of errors are taken as comprehension errors.

Encoding Errors. If the students made the correct solution to the questions but could not express the solution in acceptable written form this type of error will be taken as an encoding error.

Environment. In this study, it is a term that indicates the home environments and school environments of students.

Errors. It refers to the first mistake done by the students during the solution of the word problems. Sometimes, it may occur regularly in the learners' performance.

Motivation errors. If the student declined to proceed further due to her psychological reasons, then this type of error is classified as a motivation error.

Reading Errors. If the students cannot read the keywords or symbols of given verbal problems, this type of error will be taken as the reading error of this study.

Students. Students are the Students who are studying in sample schools in grade X.

Word Problems. The problems as with any statements have solutions. Problems are that thing which are difficult to deal with or to understand during making mathematical expressions from given word problems in this study.

CHAPTER II

REVIEW OF RELATED LITERATURE

A review of related literature is a fundamental part of the research. It is a comprehensive summary of previous research on a topic. Literature review surveys books, scholarly articles, and any other sources relevant to a particular issue, area of research, or theory, and by so doing, provides a description, summary, and critical evaluation of these works about the research problem being investigated.

The purpose of a literature review is to: Provide a foundation of knowledge on the topic. Identify areas of prior scholarship to prevent duplication and give credit to other researchers. Identify inconsistencies: gaps in research, conflicts in previous studies, open questions left from other research. The literature review is important because it describes how the proposed research is related to prior research. It shows the originality and relevance of our research problem. By reading many different studies, we will begin to gain an impression about the important aspects of the topic, identify data sources that another researcher has used, identify and become familiar with the style of writing that is used particularly within the ethos of the area that we are researching, identify ideas for further consideration and create our reading and critiquing the strategy.

There are two types of literature review which are empirical literature review and theoretical literature review. Empirical literature review deals with original research (such as scientific experiments, surveys, and research studies). They are researches based on experience and observation, rather than on systematic logic. Those theories which can be used for analysis and interpretation of data are reviewed in a theoretical review of the literature.

So, I have collected the different unpublished thesis, some books, journals, articles, and research which are related to cultural diversity and difficulty. Through a deep study of these reports, I have reviewed the following literature as academic writing:

Empirical literature

Bhatt (2021) researched on error analysis of students in learning geometry. This study's objective was to identify the errors committed by students in problem-solving in geometry and to analyze the errors from the perspectives of Newman's

theory and Van Hiele's model of thinking in geometry. This researcher was explanatory sequential design. Newman's and van Hiele's technique of error analysis was adopted as the theoretical base of the study. A test consisting of ten verbal problems from grade X compulsory mathematics was administered to the sample students to collect the required data on the content of Nepalese schools. The collected answer sheets of the students were checked and errors on those were identified based on Newman's error analysis hierarchy. An interview of fifteen students was taken to verify and explain the errors identified in the answer sheets and analyzed more errors hidden in the answer sheet. As the research tool is a written test two interview schedules were used. The interview schedule on van Hiele's levels of thinking consists of questions for the domains under geometry, corresponding to the first four levels as defined by van Hiele. Reliability of interviews was constructed by piloting repeatedly and validity was constructed with the judgment of the supervisor. About sixty percentage interviewed students were limited in visualization level therefore a maximum number of students made an error in solving problems that need the definition of geometrical items, properties of geometrical construction, and theorem that are based on geometrical content.

Tong and Loc (2017) did a study on "student's error in solving mathematical word problem and their ability in identifying errors in wrong solutions". The formulation of problem-solving skills is much more difficult than calculation skills because the problems are related to many concepts and a lot of mathematical relationships. Therefore, students inevitably commit errors to deal with them. This study shows the errors of 160, 3rd-grade students regarding some kinds of word problems in mathematics in Vietnam. The results indicate that children commit many errors due to many different reasons such as: subjectively, carelessness, wrong application of the calculation rules, incorrect identification of problem kinds, and wrong calculation.

Dulal(2014) researched the causes of errors committed by students in solving verbal problems in mathematics. The objectives of this study were to identify the different types of error and find out the causes of committing an error on solving verbal problems in mathematics at lower secondary school based on Newman's theoretical framework. He took a paper pencil test and interview the students. This research used both qualitative and quantitative research methods to analyze and

interpret data collected from students. The researcher chooses the sample schools by random sampling method in the Khotang district. This study revealed that students have committed several errors in solving verbal problems in mathematics. It showed that maximum error was committed in comprehension and transformation steps. On the other hand, there were many factors such as less practice in mathematics, lack of basic conceptual knowledge, the attitude of students towards mathematics, and teacher qualification mentioned as the causes for committing a maximum error in verbal problems.

Adhikari(2012) did a study on error analysis in solving verbal problems in probability (A study at the secondary school level. The purpose of this study was to study the patterns of errors committed by secondary-level students while solving verbal problems of probability. The objectives of this study were to identify and analyze the errors based on the Newman Theoretical framework by comparing the error made by students according to grade and knowledge, skill/ application, and problems solving level of probability to recommend some remedial measures to measure such error in verbal problems. He had taken forty students as a sample of this study from the Kathmandu district. He found errors and analyzed them according to Newman such as reading errors, comprehension errors, transformation errors, process skills errors, and encoding errors by comparing gender and type of school. From this study, the researcher found that errors were less committed by boys than by girls, students of an institutional school committed less number of errors than the students of a government school and students have fewer errors on skill and application level while solving word problems.

Joshi (2011), conducted a study entitled "Learning Difficulties in Mathematics, A Case Study of Open School Students" for the partial fulfillment of the requirements for the degree of master of education, under the department of mathematics education. The objectives of this study were to identify the difficulties in learning mathematics of arithmetic for open school students. This research followed the qualitative research design. The researcher had taken four respondents from the Kathmandu district. The researcher collected and analyzed the data through In-depth interviews and observation tools. The major finding of this research was lack of curriculum and instructional materials, lack of supportive environment, less interaction and lack of quality of instruction and lack of practice, and fast forgetting are the learning difficulties in learning mathematics.

Clements (1980) studied on analysis of children's errors on written mathematical tasks. He used methods developed by Newman and Casey for analyzing errors made by children attempting verbal arithmetic problems are described with particular emphasis being given to Newman's hierarchy of error causes. Data obtained by Newman, Casey, and Clements are presented. These show that a large proportion of errors made by children in grades five to seven in Victoria on verbal arithmetic problems are in the Newman categories: comprehension, Transformation, process skill, and carelessness.

Radatz (1979) A review of the literature on error analysis in mathematics education and on extensive investigation of errors made by German schoolchildren suggests a classification of errors and their causes in terms of information processing mechanisms. Pupils errors may be caused by the semantic difference between mathematical language and natural language by individual differences in spatial abilities deficiencies in the mastery of prerequisites by incorrect associations or failure of cognitive control and by the application of irrelevant strategies or rules.

Engelhardt(1977) conducted a study on Roberts's efforts identification and classification of computational errors by not being satisfied with Robert's classification of error types. He took an arithmetic test containing eighty-four items among one hundred and ninety-eight third sixth-grade students. The items identified as giving incorrect responses were analyzed to understand students' approaches or misconceptions leading to those responses, according to commonalities, these inferences were clustered to form errors type. This procedure resulted in the identification of eight types of errors; these were basic facts inappropriate inversion, grouping, incorrect operation, defective, incomplete algorithm and identify zero errors.

Bruker(1968) did research on the errors committed by the fifth and sixth grades in basic operations of functional numbers. He used a qualitative research design. He found eight types of errors in the addition and subtraction of fractions. Seven errors were common in both operations. The types of errors in addition and subtraction of fractions in his study were lack of comprehension of the process, difficulty in reducing to lowest form computational errors, wrong operations, partial operation changing into common denominator difficulty with improper fractions, and borrowing difficulty.

Roberts(1968) studied the failed strategies of third graders. He used a qualitative research approach. He found different errors such as wrong operation, obvious computational errors, defective algorithms, and random responses.

Theoretical Literature

The theoretical framework defines the key concepts of the study. A strong theoretical framework gives a sound scientific basis, demonstrates your understanding of existing knowledge on the topic, and allows the reader to evaluate guiding assumptions. It provides direction for research, allowing strongly interpreting, explaining, and generalizing from your findings. In this study, there is also some theoretical framework review to make the study scientific basis and to make the clear guideline for the study.

Newman Theory of Errors Analysis

The Australian educator Anne Newman (1977) suggested five significant prompts to help determine where errors may occur in students' attempts to solve written problems. According to Newman's definition, students' errors in solving word problems are classified as follows:

- Reading the words [Reading error]
- Understanding what they have read [comprehension]
- Transforming what they have read to be able to form a course of action [Transformation]
- Following through on procedures [Process skills]
- Encoding the result of a procedure to answer the question [Encoding]

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

- Please read the question to me (Reading)
- Tell me what the question is asking you to do (comprehension)
- Tell me a method you can use to find an answer to the question.
(Transformation)

- Show me how you worked out the answer to the question. Explain to me what you are doing as you do it. (Process Skill)
- Now write down your answer to the question. (Encoding)

Comprehension strategies are the cognitive and metacognitive strategies a reader use to accomplish the goal of comprehension. Comprehension strategies are interrelated and will rarely be used in isolation. The six key strategies are making connections, predicting, questioning, monitoring, visualizing, and summarizing.

Newman found that reading error, comprehension error, transformation error, process error, and encoding error. The five questions the teacher asks to link to the five processes involved in solving a written mathematics problem. If when reworking questions using the Newman analysis the students can correctly answer the question. The original error is classified as a carelessness error.

Conceptual Framework

A conceptual framework is an analytical tool with several variations and contexts. It is used to make conceptual distinctions and organize ideas. Strong conceptual frameworks capture something real and do this in a way that is easy to remember and apply. A conceptual framework covers the main feathers (aspects, dimensions, factors, variables) of the researcher and their presumed relationship.

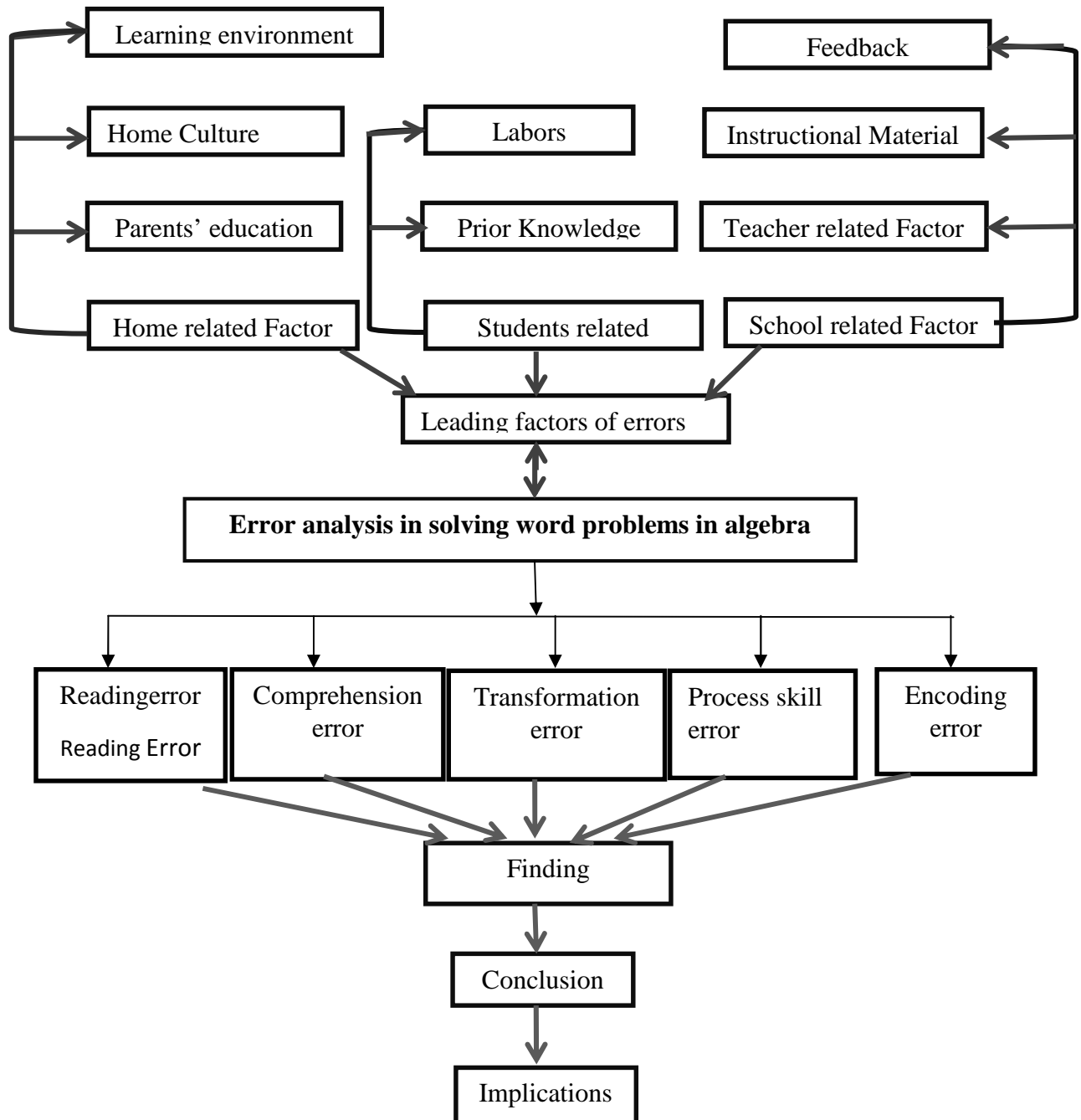


Figure 2.1

Conceptual Framework bottom

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

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

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

Process skill errors. An error is classified as a process skill error if the students identify an appropriate operation or sequence of operations, but do not know the procedures necessary to carry out these operations accurately.

Encoding error. An error is classified as an encoding error if the students correctly work out the solutions to the problem, but could not express the answer in an acceptable written form.

Implications of the review for the study

The review of related literature is one the most of any study or research as it provides the theoretical and empirical back up to the related present study. This will provide the fundamental knowledge on the topic, and helps to identify the inconstancies gaps in research. The related review will provide information that how the proposed research is related to prior research. For this study, the related review of literature will show the originality and relevance of the study, provide the important aspect of the study, identify the data sources, the population of the study, and familiar with the design of the study, and provide the further consideration of the study. Thus the review of related literature will be more implicated in this study.

CHAPTER III

METHODS AND PROCEDURES

Research methods and procedures are useful bridges to solve the research problems systematically. It describes the methods and processes applied in the entire aspect of the study. The research method is a plan of study worked out before the commencement of research work by a researcher to gain new knowledge to solve a problem scientifically.

This chapter will describe the plans and procedures of the study under the separate heading which must be carried out to achieve the objectives of the study, participants of the study, tools for data collection, interview schedule, classroom, observation form, validity, and reliability of tools, data collection procedures, and data analysis procedures.

Design of the Study

This study had the objectives to find errors done by the students in solving word problems in algebra and identify the leading factors that affect solving word problems in algebra. So researcher used a case study approach under qualitative research design. A case study is a research approach that was used to generate an in-depth, multi-faceted understanding of a complex issue in its real-life context. It was an established research design that is used extensively in a wide variety of disciplines, particularly in the social sciences. The goal of case study research was to understand the complexity of a case in the most complete way possible. The researcher used the Newman techniques as the theoretical base of this study and based on the Newman procedure to identify types of errors and interview schedules the result was analyzed.

Research site

All the grade X students of the Ilam district will be taken as the population of this study.

Respondents of the Study. In research terms, a sample is a group of people, objects, or items that are taken from a larger population for measurement. The sample should be representative of the population to ensure that we can generalize the findings from the research sample to the population as a whole. Based on the population of this study two schools from the Ilam district will be chosen as the

sample school of this study. The students who are studying in grade X will be taken as the sample students of this research.

Sampling Strategy

It is a way of choosing or selecting a sample from a large population. I will use the purposive sampling procedure to bring out sufficient data for the case study.

Research Tools

Research tools are the instruments that were used to collect the data. In this study, I used a paper-pencil test, in-depth interview, and field visit.

The data needed to get the first objectives of this study were collected by taking a paper-pencil test/ written test. The paper pencil test had 13 verbal questions selected from the algebra of class X. Questions were selected according to the specification grid of class X prepared by the curriculum development center. Similarly, data needed to fill the second objective of this study were collected through interviews with students, subject teachers, and principals of sample schools.

Reliability and Validity of Tools

Written test. The reliability of the written test is determined by the pilot test. The content of the written test schedule has been selected based on the grade X algebra curriculum. The validity of the test was established with the help of an internal supervisor, experts, subject teacher, and other related documents.

Interview schedule. The reliability of both interview schedules the interviews, the conducted repeatedly on 15 students included in pilot testing. The content of the interview schedule has been selected based on the grade X geometry curriculum and is the basis of the objectives of the study, Validity of both interviews has been ensured by the critical judgment of the supervisor.

Quality Standards

Quality standards are defined as documents that provide requirements, specifications, guidelines, or characteristics that can be used consistently to ensure that materials, products, processes, and services are fit for their purpose. Quality research most commonly refers to the scientific process encompassing all aspects of study design; in particular, it pertains to the judgment regarding the match between

the methods and questions, selection of subjects, measurement of outcomes, and protection against systematic bias, nonsystematic bias, and inferential error (Boaz & Ashby, 2003).

In research, for the quality standard, trustworthiness is one of the most essential parts. Every research must contain its norms and value.

Trustworthiness. Trustworthiness is the ability to be relied on as honest or truthful. Trustworthiness of a study refers to the degree of confidence in data. Due to the nature of qualitative research, there may be many doubts that occur during and after the research process. Through trustworthiness, every doubt about this nature of research may be minimized through the aspect of trustworthiness. Trustworthiness has four key components: credibility, transferability, dependability, and conformability. (IHRCS, 2016)

Credibility.to determine the trustworthiness of any qualitative searcher, credibility is one of the important aspects or criteria that must be established in such types of research. This helps to link the research study's findings with reality to demonstrate the truth of the research study's findings. Credibility refers to the extent to which a research account is believable and appropriate, with particular reference to the level of agreement between participants and the researcher. (Mills, Durepos&Wiebe, 2010). Especially, credibility contains the triangulation and member checking in research

Triangulation involves utilizing different data collection methods to check the consistency of the findings. In this research, the researcher used in-depth interviews, observation, and document analysis. Through the information taken from different tools, the researcher has concluded this study

Member-checking is the second important technique that qualitative researchers use to establish credibility. This is a technique in which the data, interpretations, and conclusions are shared with the participants. It allows participants to clarify what their intentions were, correct errors, and provide additional information if necessary.

Transferability. Transferability referees the generalization of research findings to other situations and contexts. Transferability is established by providing

readers with evidence that the research study's findings could apply to other contexts, situations, times, and populations.

In this research; to maintain the transferability of the research, the researcher has taken a sample by using a purposive sampling procedure and included photos of achievement tests and records of all the activities done during the research. As well as, the researcher has taken many guidance and suggestions from the expertise.

Dependability.In research, dependability implies the stability of research findings over time and situations. Dependability involves participants' evaluation of the findings, interpretation, and recommendations of the study such that all are supported by the data as received from participants of the study. (Kortjens& Moser,2018).

In this research, the researcher had observed the research area to know the real reality of this group's students and has done some conversations with other communities persons for getting the reality as well as take some guidance and suggestions from the experts.

Conformability.Conformability is the last criterion of Trustworthiness that a qualitative researcher must establish.This criterion has to do with the level of confidence that the research study's findings are based on the participants' narratives and words rather than potential researcher biases. Conformability is concerned with establishing that data and interpretations of the findings are not figments of the inquirer's imagination, but derived from the data. (Kortjens& Moser ,2018).

In this research. the research study's findings are based on the participants' narratives and words rather than potential researcher biases.

Data Collection Procedure

For every study, the data collection procedure is very important; to collect the qualitative data, the researcher contacted and visited government schools. Then the researcher had taken permission from the head teacher of selected schools. Similarly, the researcher had requested to mathematics teacher to help in conducting exams and interviewing students. In this work researcher made a question paper for grade X students with the help of the past paper and interview schedule, the researcher had taken the exam of all grade X students and interviewed fifteen students one by one.

Then all the answer had analyzed and categorized on different errors with the help of Newman's error analysis procedure. I had taken in-depth interviews with students, subject teachers, and principals of sample schools. Finally, I thanked to administration, teacher, students, and parents and to all who had helped me study for their kind support and help. Also, I had created an environment where I could call and get the information whenever I needed information from their stakeholder.

Data analysis and Interpretation Procedure

There are different methods of data analysis. The errors were identified with help of Newman procedures as reading error, comprehensions error, transformation error, process skill error, and encoding errors. This study was based on a case study under a qualitative research approach. So, qualitative data was organized; coding, theme writing, comparing and then findings and conclusion were found for the study.

Ethical Consideration

This study was conducted only for academic purposes. While collecting the data, ethical considerations were taken to ensure data privacy. Regarding this study, I informed my purpose to my respondents. I had not used the data for the other purpose except for my research work I did not bring out anything that had affected the prestige of my respondents.

CHAPTER IV

ANALYSIS AND INTERPRETATION OF DATA

This is a survey study related to the error analysis in solving word problems in algebra at the secondary level. The motive of this study was to categorize and identify the errors committed by the students of grade X in solving work-related problems of algebra, and to find out the causes that played role in solving word problems in algebra in mathematics. For the accomplishment of this purpose, students of grade X were selected from two public schools Bhanubhakta HSS and Gyanodaya HSS in the Ilam district. In the sample, there were 30 students and they were selected with the help of a regular mathematics teacher. The main tools for the collection of data were the test items. The test was taken the identification the error. The error identified in the answer sheet was classified following Newman's technique of error analysis as the theoretical base.

Analysis of Data According to Newman's theory

The following table shows the errors in various categories combined with the total number of errors and their percentage according to the test items. This table shows all the three hundred ninety (390) errors found in different categories.

Table 4.1 Classification of Errors

Errors	Reading Error	Comprehensive Error	Transformation Error	Process Skill error	Encoding Error	Total
No. of Error	77	120	68	60	65	390
Percentage	19.7%	30.7%	17.7%	15.3%	16.6%	100%

Table no. 4.1 shows that among all the categories the highest number of errors (30.7%) were identified on a comprehensive error and the lowest number of errors (15.3%) were identified in process skill-related error. This shows that students read the question and problem well but cannot relate to the meaning and demand of the problem.

Error wise Analysis

The observable error in solving word problems in algebra could be categorized under the following headings. The researcher has analyzed the following five types of errors committed by students with the help of Newman's theory that are described accordingly;

Reading Error

Reading error is committed by students while reading keywords or symbols used in written problems. When students neglect the demand of the problem by not reading the question seriously then this type of error occurs. Symbolization, language, and vocabulary play a vital role, especially in this kind of error. 19.7% reading error shows that a huge number of students have difficulty reading the presented problem.

Comprehension Error

If the students can read the problems well but cannot realize the meaning of words, symbols, or questions then comprehensive errors occur. In this situation, students cannot visualize the way of solving problems because of a lack of information about the demand of the problem and its nature.

The researcher provides the question i.e. 14 years ago the age of the mother was 4 times the age of her daughter. The present age of the mother is 2 times the age of her daughter will be 4 years hence. What are their present ages? Then one of the students solved this problem as follows.

Solution,
 Let the present ages of the mother and the daughter ~~be~~ is x and y years.

Then:

$$\begin{aligned} x \times 14 &= 4y \times 14 \\ 14x &= 56y \quad \text{--- (1)} \end{aligned}$$

Again:

$$\begin{aligned} x &= 2(y-4) \\ \text{or } x &= 2y-8 \end{aligned}$$

From (1) and (2):

$$\begin{aligned} 14(2y-8) &= 56y \\ \text{or } 28y-28 &= 56y \\ \text{or } 28y-56y &= 28 \\ \text{or } -28y &= 28 \end{aligned}$$

(Comprehension Error.)

From the above way of problem-solving, the researcher analyzed that the student has gone wrong to comprehend the problem related to an algebraic equation. Due lack of comprehension of the relation between ages and times and having the issue to transform that word problem into the correct equation this problem was raised.

While conducting the test, 30.7% i. e highest number of errors were committed in comprehension errors, this indicates that a noticeable number of students were not able to be on the threshold of an appropriate way of solving presented word problems related to algebra.

Transformation Error

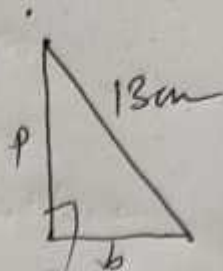
An error is classified as a transformation error; if the student had understood what the question was asking about but was unable to recognize the pattern of operation needed to solve the problem. In transformation error, students cannot create an appropriate strategy to solve the problem even though students are aware of what the problem demands.

The researcher gave the question to one of the students, "Hypotenuse of a right-angled triangle is 13cm and the difference between the remaining two sides is 7cm. find the sides of the triangle." One of the students solved the problem as follows;

Solution:
 Hypotenuse = 7cm
 Here, perpendicular = p
 Base = b
 We know,
 $p - b = 7$
 Now, $p + b = h$
 We have
 $p - b = 7$
 Now:

$$\begin{array}{r} p - b = 7 \\ p + b = h \\ \hline 2p = 7 + h \\ h = 2p - 7 \end{array}$$

 Again:
 $h = 7\text{cm}$
 So,
 $2p - 7 = 7$
 $2p = 7 + 7$
 Or,
 $p = \frac{14}{2}$
 $p = 7$



Transformation Error!

Looking at the solution, the researcher has analyzed that the student had identified the problem but was unable to make the strategy to solve the problem but he/she couldn't find a suitable way of solving or appropriate solving method.

While conducting the test, 17.7% which means, the third highest number of students were attempting transformation error. Those were the students who had understood the question but couldn't find the way through finding the solution.

Process Skill Error

An error is classified as a process skill error when a student identifies the appropriate operation or sequence of operations but does not know the procedure necessary to carry out those operations accurately. In other words, the student can choose an appropriate operation but cannot complete the operation correctly. If the students were not able to solve the problem with the required process.

The researcher presented the question " In several two digits, the sum of the digits is 10. If the places of the digits are interchanged, the new number becomes one less than twice the original number. Find the original number."

10th

Here:
Let the number be
 $10x + y$. So:
1st condition:
 $x + y = 10$
or, $x = 10 - y$ — (i)

2nd condition:
 $10y + x = 2(10x + y) - 1$
or, $10y + x = 20x + 2y - 1$
or, $8y - 19x = -1$
or, $19x - 8y = 1$ — (ii)

From (i) & (ii):
 $x + y = 10$
 $\Rightarrow x + y = 10 \quad \times 19$
 $19x + 19y = 190$
 $8y - 19x = -1$

 $27y = 189$
 $y = 179/11$

process skill error

Observing the solution, the researcher analyzed that the student had identified the correct way of solving the given problem but the student failed to proceed to the further step. While conducting test items, 15.3% of students committed process skill errors this shows that a recognizable number of students found difficulties to achieve the solution by adopting the required process.

Encoding Error

If the students correctly worked out the solution to the problem but couldn't express the solution in acceptable written form, this form of error is classified under encoding error. In other words, if the student is unable to use appropriate sign letters in the appropriate place and does not conclude the answer correctly. In encoding error, the student can perform the correct operation but does not write the answer correctly.

The researcher gave a question, "The sides of a rectangle are in the ratio 3:2. If its perimeter is 40cm, find its area."

Solution:

Let the sides be $3x$ and $2x$

We know,

$$\text{Perimeter (P)} = 2(l + b)$$

$$40 \text{ cm} = 2(3x + 2x)$$

$$40 = 2 \times 5x$$

$$40 = 10x$$

$$\therefore x = \frac{40}{10} = 4 \text{ cm}$$

and, ~~y~~

$$\text{length} = 3x = 3 \times 4 = 12 \text{ cm}$$

$$\text{Breadth} = 2x = 2 \times 4 = 8 \text{ cm}$$

$$\text{Area (A)} = l \times b$$

$$= 12 \text{ cm} \times 16 \text{ cm}$$

$$= 192 \text{ cm} \text{ Ans.}$$

↓
Encoding Error.

Witnessing the solution, the researcher has analyzed that the student had performed the correct way but failed to write the final term in the correct or acceptable form. Thus, according to Newman, it was an encoding error. While conducting the test items, 16.6% of students committed encoding errors so that the students were not able to use the appropriate place and did not write the answers correctly.

Causes of errors committed by students

With the help of Newman's error analysis procedures, the five types of errors were classified by the researcher. The data collection program was conducted on students through interviews. The interview program was performed based on interview guidelines to find the causes of errors. Many students committed different five types of errors while solving the word problems related to algebra. The causes of each error are explained below;

Causes of Reading Error

Reading error was found by giving students the questions to read. The error was included in the reading error when the students were unable to read out the given question properly. 19.7% of students committed reading errors according to the test items in the survey. The researcher found the following causes of making reading errors ;

Lack of concentrated study, pre-essential knowledge, and poor understanding of the algebraic concept.

Poor background in language, lack of feedback.

Giving less emphasis on reading questions in the classroom.

Lack of knowledge to recognize the symbols used in mathematics.

In conclusion, carelessness, lack of motivation, hesitation, poor background knowledge, and lack of knowledge of technical terms, symbols, and voice are responsible for causing reading errors. To minimize the errors teachers should encourage students to deep and concentration-oriented study, well algebraic concepts should be provided and teachers should pay special attention to the mathematical language.

Causes of Comprehension Error

The error was kept under the comprehension error when students were unable to catch what the question asked. It was found out through the answer sheet and interview. 30.7% of students committed comprehensive errors according to the research, which seems a large number of errors. The researcher found the following causes of comprehensive error;

- Less emphasis on work-related problems.
- Lack of pre-acquired knowledge.
- Lack of knowledge of technical terms in mathematics.
- The monopoly of rote learning and result-oriented study.
- Lack of classroom management and noise.
- Partial attendance and attention of students in the classroom.
- Lack of using teaching materials.
- One way of teaching and learning.

In conclusion, a monotonous environment, lack of knowledge of technical terms, incomplete explanation, overload of work for students, and lack of basic and conceptual knowledge about algebra are the main causes of comprehension errors. To minimize the error, basic and pre-knowledge should be given, and teachers should emphasize using teaching materials and making the classroom interesting.

Causes of Transformation Error

The error was included under transformation error when it was found that students had difficulties in selecting appropriate procedures to solve the presented questions. 17.7% of Students committed transformation errors which seems a huge amount. The researcher found the following causes of transformation error;

- Lack of concepts and meaning of the mathematical words.
- Inappropriate knowledge to identify the correct procedure to solve the given problem.
- More emphasis on a product than the process.
- Lack of revision and concept-based study.
- Lack of classroom discussion.
- Lack of proper planning.
- Lack of multidimensional way of thinking.

In conclusion, it can be stated that lack of conceptual study, classroom discussion, planning, and motivation are the main causes that play a vital role in causing transformation error. To minimize transformation error, teachers should focus on process rather than product, and teachers and students too should emphasize classroom discussion.

Causes of Process Skill Error

The error was included under process skill error when it was found that students had complications in performing the procedure accurately while solving the given question. 15.3% of students committed process skill errors which were revealed after observing the answer sheet of the test. The researcher found the following causes of process skill error.

Lack of teaching materials in algebraic problems.

Lack of confidence in students about the formulae and mixed concepts of algebraic relations.

Lack of generalization of algebraic concepts to the solution.

Lack of motivation, regular tests, and feedback.

Lack of required guidance to the students.

In conclusion, from the study of the above statements the researcher found out that process skill error is raised due to mixed-up rules, congested thinking, and lack of guidance and monitoring. To minimize process skill error, teachers should generalize algebraic concepts to the solution accordingly; regular motivation, monitoring, and guidance should be provided.

Causes of Encoding Error

The error was included under encoding error when it was found that students had not expressed the solution or had not written the conclusion part of the solution in acceptable form. In the test, 16.6% of students committed encoding errors. The researcher identified the following causes of encoding errors;

Lack of teacher's proper instructions while solving problems.

Due to the carelessness of students.

Lack of homework and classwork checking.

Lack of monitoring and evaluation while solving algebraic problems.

Lack of creative and critical thinking.

Less importance to arranging the procedure.

In conclusion, from the above statements, the researcher found out that lack of guidance, monitoring, and carelessness are the main causes of encoding error. To minimize encoding errors proper monitoring and evaluation of students should be done, students should be careful while solving algebraic problems and should try to develop creative and critical thinking.

CHAPTER-V

SUMMARY, FINDINGS, CONCLUSION & RECOMMENDATIONS

This chapter deals with the result and findings of the study “An error analysis in solving word problems in algebra at secondary level”. This chapter includes four sections; summary, findings, conclusion, and recommendation. The data are analyzed to find out the conclusion which helps to fulfill the objectives of the study.

Summary and Findings

The study was aimed at fulfilling three objectives. They were to categorize the errors committed by the students of grade X in solving word problems of algebra, analyze the errors committed by the students while solving word problems of algebra, and find the causes of error in solving the word problems of algebra in mathematics in the secondary level. The sample in this study consisted of 30 students from two public schools in the Ilam district. The schools were purposely selected. The major tool used for the study were written tests and interviews. Errors from the test were analyzed by applying Newman's technique of error analysis. Errors were collected from answer sheets. From the test, all the identified errors were classified into five categories as recommended by Newman and the frequency of each type of data was tabulated. The five categories of Newman's error test were reading error, comprehension error, transformation error, process error, and encoding error. If the student couldn't read the keyword from the problem it was included in the reading error. If the student couldn't grasp the overall meaning of the word the error was included in the comprehension error. The error was included in the transformation error if the student couldn't identify the sequence of operations to solve the problems. Similarly, if the student did not know the procedure to carry out the exact operation accuracy then that error was included in process error and finally, an error was classified into encoding error if the solution was not in acceptable form. The written test paper was prepared with the help of a subject specialist, guide, and experienced mathematics teacher. By analyzing the test the different types of errors were identified based on Newman's theory. The errors in every five problems were classified and later the errors in total were tabulated.

Hence, the research was conducted to investigate the errors of grade X students in word problems related to algebra mainly concerning Newman's level of errors, the following findings were obtained;

Among sampled students, most of the students committed any one of the errors in solving different algebraic reading errors, comprehension errors, transformation errors, process skill errors, and encoding errors.

There were a total of 390 errors committed by the students and most errors were committed in comprehensive error (30.7%) and the least error was committed in process skill error (15.3%).

The causes of reading error were; hesitation, poor background knowledge, and lack of knowledge of technical terms, symbols, and language.

The causes of comprehension error were; a monotonous environment, lack of knowledge of technical terms, incomplete explanation, overload of work for students, and lack of basic and conceptual knowledge about algebra.

The causes of transformation error were; Inappropriate knowledge to identify the correct procedure to solve the given problem, more emphasis on a product than the process, and a Lack of multidimensional way of thinking.

The causes of process skill error were; mixed-up rules, congested thinking, and lack of guidance and monitoring.

The causes of encoding error were; the carelessness of students, lack of homework and classwork checking, lack of monitoring and evaluation while solving algebraic problems, and lack of creative and critical thinking.

Proper materials were not used while teaching algebra at the secondary level. To minimize the errors in teaching and learning algebra teachers should encourage students to deep and concentration-oriented study, well algebraic concepts should be provided and teachers should pay special attention to the mathematical language as well as process based and concept-based teaching should be done rather than product oriented.

Motivation and pre-knowledge about algebra should be given to the students and proper materials should be used.

Conclusions

This study "An Error Analysis in Solving Word Problems in Algebra at Secondary Level" identified the errors made by the students of grade X while solving word problems in algebra, analyzed the causes of committing errors, and also provided ways of minimizing the errors. This study included both quantitative and qualitative methods, where a written test was used for collecting quantitative data, and

the interview was used for qualitative data. The main motive of the study was to categorize and analyze the errors committed by the students while solving word problems of algebra at the secondary level. Hence the study found the following results;

Teachers should use concept-based teaching rather than exam and product-based teaching, teachers should use proper materials while teaching new concepts. The teacher should motivate students toward learning, homework classwork and other study-based student activities should be monitored regularly to enhance the quality of students' concept of algebra and to bring accuracy to work-related problems. Students should study the word problems of algebra with concrete concepts rather than parrot learning. School administration, parents, teachers, and students should obey their responsibilities to enhance and achieve their ultimate goals accordingly. Hence the quality of algebra and education can be improved by reducing errors and enhancing concept-based learning.

Educational Implications

This study helps the textbook writer, curriculum designer, and policy maker to revise the textbook, and construct the curriculum by using information from this research related to word problems in algebra. As well as teachers can also get notified about what errors students may commit while solving word problems related to algebra at the secondary level and it helps to make plans accordingly. The following are the educational implications of this study;

This study helps students to solve word problems related to algebra correctly.

This study helps textbook writers, curriculum designers, and policymakers to enhance the quality of contents of the textbook, curriculum, and policy.

This study helps to improve the achievement of algebra in mathematics at the secondary level.

Teachers will be aware of the possible errors that can be committed by their students in word problems related to algebra at the secondary level.

Parents will be aware of the errors that can be made by their children in mathematics, especially in algebra.

It helps to find out the causes of making errors in word problems in algebra.

This study also recommends ways of minimizing errors related to word problems in algebra that can be fruitful for concerned authorities.

The findings of this research can be applied to other branches of mathematics and other districts of Nepal.

Recommendations for Further Study

The result and conclusion of this study generate some other questions which need to be verified.

What would be the effects of error analysis in teaching learning of mathematics in the classroom?

How the errors committed by students can be minimized?

What would be the individualized instruction in reducing the error committed by students?

What would be the result of error analysis at a lower and higher level?

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APPENDICES**Appendix-A**

Test Questionnaire

Class-X

Sub-Comp. Mathematics

Full Marks-30

Time- 1hr

Attempt all the Questions**Group-A [4*1=4]**

1. If x is a multiple of y , what is the HCF of x and y ?
2. If a number is decreased by 75% then the remainder is 75, what is that number?
3. If the reciprocal of a number is added to the number, it becomes 2. What is that number?
4. If the product of ages of a boy 3 years ago and 3 years later is equal to the square of his age a year ago, then what is his present age?

Group-B [5*2=10]

5. The sum of the two numbers is 60 and their difference is 10. Find the number.
6. The total cost of a watch and radio is Rs 500. If the watch is cheaper than the radio by Rs 150, find their cost.
7. The sum of ages of a father and a son is 38 years. If the father is 22 years older than the son. Find their present ages.
8. When 5 is subtracted from the square of a number the difference will be 11. Find the numbers.
9. Divide 11 into two parts so that their product will be 24.

Group- C [4*4=16]

10. In several two digits, the sum of the digits is 10. If the places of the digits are interchanged, the new number becomes one less than twice the original number. Find the original number.

11. Some students planned a picnic. The budget for the food was Rs 2,500. As five of them were unable to join the picnic, the cost of the food for each student increased by Rs 25. Find how many students went for the picnic.
12. A two-digit number is three times the sum of its digits. The sum of the number formed by reversing its digits and 9 is equal to three times the original number. Find the number.
13. Hypotenuse of a right-angled triangle is 13cm and the difference between the remaining two sides is 7cm. find the sides of the triangle.

Appendix-B

SN	Name of students	Questions numbers												
		1	2	3	4	5	6	7	8	9	10	11	12	13
1	Avishek Pandey	Ce	Re	Ce	psc	Re	Ce	Psc	Ee	Te	Ce	Re	Pse	Re
2	Anupama Sapkota	Re	Ce	Te	Ee	Psc	Te	Ee	Ce	Ce	Te	Re	Psc	Ce
3	Bigyan Rai	Psc	Re	Te	Ce	Ee	Ce	Ee	Re	Psc	Re	Ce	Te	Pse
4	Chetana Dhakal	Ce	Re	Ee	Te	Ce	Pse	Re	Ce	Ee	Re	Ee	Ce	Te
5	Chintan Majhi	Pse	Re	Ce	Ee	Re	Pse	Ce	Te	Re	Ee	Te	Ce	Re
6	Digvijay Bhandari	Ce	Re	Te	Ee	Ce	Re	Ee	Ce	Ee	Pse	Ce	Pse	Ee
7	Elisha Rai	Re	Ee	Ce	Re	Ee	Te	Ce	Ee	Ce	Ee	Re	Ee	Te
8	Hari Pandey	Pse	Ce	Re	Te	Re	Pse	Ee	Te	Re	Ce	Ee	Re	Pse
9	Hemanta Koirala	Re	Pse	Ce	psc	Ee	Ce	Re	Ce	Pse	Re	Ce	Ee	Ce
10	Janaka Rai	Ee	Te	Re	Pse	Ce	Ee	Te	Ce	Pse	Ce	Re	Ce	Ee
11	Jiwan Pokhrel	Te	Re	Ce	Ee	Ce	Re	Pse	Ce	Te	Re	Pse	Te	Re
12	Jyoti Singh	Ce	Te	Re	Pse	Te	Pse	Re	Ee	Re	Te	Ce	Ee	Ce
13	Kewal Basnet	Pse	Ce	Re	Ce	Te	Ee	Ce	Re	Ee	Ce	Re	Te	Te
14	Kusum Shrestha	Ce	Re	Ce	Ee	Pse	Ce	Pse	Re	Ce	Ee	Ce	Pse	Ce
15	Kaben Rai	Te	Ce	Ee	Ce	Re	Ee	Ce	Ee	Te	Pse	Re	Te	Ee
16	Muna Magar	Ee	Te	Ce	Pse	Te	Ce	Pse	Re	Ee	Ce	Pse	Pse	Re
17	Mukesh Basnet	Ce	Te	Re	Ce	Ee	Ce	Re	Te	Ce	Te	Ce	Pse	Ce
18	Muskan Adhikari	Pse	Ce	Pse	Re	Ce	Ee	Ce	Te	Ee	Ce	Pse	Ce	Te
19	Niharika Rai	Ce	Re	Ce	Te	Ee	Ce	Ee	Ce	Te	Re	Ce	Te	Pse
20	Nischal Magar	Ee	Ce	Re	Pse	Ce	Te	Ce	Re	Pse	Ce	Ee	Re	Ce
21	Nutan Pokhrel	Re	Ee	Ce	Te	Pse	Ce	Pse	Re	Ce	Ee	Te	Ce	Re
22	Parbatirai	Ee	Ce	Pse	Ce	Re	Te	Ce	Pse	Te	Ce	Ee	Re	Te
23	Puspa Bas	Te	Pse	Re	Ee	Ce	Pse	Te	Ce	Te	Ee	Te	Ce	Ee

	net													
24	Rohan Magar	Ce	Ee	Re	Ce	Ee	Ce	Re	Te	Ce	Pse	Te	Ce	Re
25	Raj Shakya	Ce	Re	Ce	Ee	Re	Ee	Ce	Te	Ee	Ce	Pse	Te	Ce
26	SaritaRai	Pse	Te	Ee	Re	Pse	Pse	Te	Ee	Ce	Ee	Te	Ee	Te
27	SangamRai	Ee	Ce	Te	Pse	Ee	Ce	Ee	Re	Ee	Te	Ce	Re	Pse
28	SugamMagar	Ce	Te	Re	Ee	Ce	Pse	Re	Ce	Pse	Te	Re	Pse	Ce
29	Tara Pokhrel	Re	Ce	Re	Ce	Ee	Re	Ee	Ce	Pse	Ce	Ee	Re	Te
30	Yuwaraj Pokhrel	Ce	Ee	Ce	Te	Te	Ce	Re	Pse	Ce	Te	Ce	Te	Re

Re= Reading Error

Ce=Comprehension Error

Te=Transformation Error

Pse=Process Skill Error

Ee=Encoding error

Appendix-C

Interview questions for finding the error related to the Newman procedure of error analysis.

Please read the question to me. (Reading)

Tell me what the question is asking you to do. (comprehension)

Tell me a method that you can use to find an answer to the question.

(Transformation)

Show me how you worked out the question. (Process Skill)

Now write down your answer to the question. (Encoding)

Appendix-D

Interview Guidelines for Students

Related to the Teacher

The behavior of the teacher in the classroom

Relation with other teachers and student

Teaching style

The effort of the teacher to teach content

Related to students

Attitude in classroom

Participation in mathematical programs or outside school even classroom

Like or unlike subjects

Interest in mathematics as well as mathematics-related subjects

Relation with teacher

Peer group relation

Plan

View towards mathematics

What pressured to, unlike mathematics? (Searching their view)

Related to School Environment Condition

Physical facilities(desk, Bench, board, etc)

Library conditions

Latrine situation

Instructional material

Related to Teaching process and materials

Teaching method frequently used by the teacher(Students centered/ Teacher centered)

Materials used

Related to Family Background

Family's educational status

Family's economic condition

Role of parents(support/negligence/natural)

Home environment(Educational environment)