EFFECTIVENESS OF INSTRUCTIONAL MATERIALS ON MATHEMATICS ACHIEVEMENT OF STUDENTS

A

THESIS

BY

BIMAL THAPA

FOR THE PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF MASTER OF EDUCATION

SUBMITTED

TO

DEPARTMENT OF MATHEMATICS EDUCATION

CENTRAL DEPARTMENT OF EDUCATION

UNIVERSITY CAMPUS

TRIBHUVAN UNIVERSITY

KIRTIPUR, KATHMANDU

2016

LETTER OF APPROVAL

A

Thesis by

Bimal Thapa

Entitled

Effectiveness of Instructional Materials on Mathematics Achievement of Students

has been approved in partial Fulfillment of the requirements for the Degree of Master of Education.

Committee for Viva-Voce	**Signature**
1. Asso. Prof. Laxmi Narayan Yadav (Chairman)	……...
2. Prof. Dr. Hari Prasad Upadhyay (Member)	……
3. Prof. Dr. Binod Prasad Dhakal (Member)	…….

Date: 8th April, 2016

LETTER OF CERTIFICATE

This is to certify that Bimal Thapa, with campus Roll No.: 1066/68 T.U., Exam Roll No.: 281490, Thesis Number 1101 and T.U. Registration No. 9-2-573-19-2007 has completed this thesis under my supervision for the period prescribed by the rules and regulations of Tribhuvan University. The thesis entitled **"Effectiveness of Instructional Materials on Mathematics Achievement of Students"** embodies the result of her investigation conducted during the period of 2072 BS. This thesis is submitted and forwarded for evaluation and recommend to award the degree of Master of Education.

…...…….……..... .....…….

(Prof. Dr. Binod Prasad Dhakal) (Asso.Prof. Laxmi Narayan Yadav)

Supervisor Head

Date: 8th April, 2016

ACKNOWLEDGEMENTS

Acknowledgements though look formal, are essential more particularly in the area of research. An individual achievement in research can't perfectly be produce of only one's own effort, rather of many persons' help. In this research work, I owe both tangible and intangible debts to many. Thus, the expression of a sense of gratitude to all persons and institution has become a human responsibility of mine.

I owe a deep debt of gratitude to Prof. Dr. Binod Prasad Dhakal for his invaluable guidance, suggestion and encouragement given to me at every stage right form selection of the problem till the completion of the thesis. His keen interest and able guidance in this research have been a source of great inspiration for me.

I would like to express my sincere appreciation to the Head of Department of Mathematics Education and all my respected guru of department of education, University Campus, Kirtipur for guiding me whenever it was need.

My special thanks go to teachers and students of Gyanodaya Secondary School and Shree Secondary School of Kawasoti, Nawalparasi District. For their kind cooperation, words alone can't express my appreciation to them.

I would like to express deepest gratitude to my parents and other family members who always encourage me to continue my higher studies and whose precise suggestion, cooperation helped me to be a good mathematics educator in my life.

I would like to express my gratitude to my all friends who helped me directly and indirectly in my research work.

…….

Bimal Thapa

ABSTRACT

In the educational field in Nepal the teachers and students are facing many problems in teaching learning process. In Algebra, teachers face many problems while giving clear concepts to the students. It is obvious that the use of instructional materials helps the students for better understanding and thus better achievement. Instructional material can be used to facilitate teaching and motivate students for clear instruction. These materials are linked to the sensory organs and they provide the visual and sensory experience to the students. So, the researcher intended to study the effectiveness of instructional materials in teaching algebra at lower secondary level grade VIII with the following objective.

1. To find out the effectiveness of instructional materials in teaching algebra.

2. To compare the achievement of students in algebra taught by using instructional materials and not using instructional materials.

The design of this study is pre-test post-test non-equivalent control group design of experiment. In order to fulfill these objectives the researcher selected two schools randomly in Nawalparasi district. From each school 20 students of grade VIII were selected for sample of the study. The experimental and control groups were determined by tossing a coin. Both experimental and control groups were taught by researcher on the topic algebraic expression at grade VIII. The experimental group was taught by using manipulative instructional materials and control group was taught without using these factor kids (i.e. by conventional method). Pre-test was administered before the experiment started. The experiment run for the duration of 20 days. After 20 days post-test was administered on both groups and the mean scores was calculated. The different in mean achievement scores are tested by using t-test at 0.01 level of significance.

Same content was taught to both the experimental and control groups from the same curriculum, same textbook prescribed by Government of Nepal. An achievement test paper was the main instrument for data collection for the study. Some questions were developed by researcher himself, some questions were taken from teacher's guide and specification grid of grade VIII which were published from CDC, Sanothimi Bhaktapur. For the pilot study twenty-four items were kept.

Finally, the researchers concluded that the achievement of the students of experimental group is better than the achievement of the students of control group. So, algebra teaching by using different manipulative instructional materials causes better achievement than teaching without such instructional materials.

TABLE OF CONTENTS

Page No.

Chapter I

INTRODUCTION

Background of the Study

Those instruments, which are useful, essential for teaching learning activities in classroom are called instructional materials. These are essential for the mathematics teacher as spices are for the chef. These materials are necessary, extra ingredients, which make teaching and learning mathematics a pleasant, satisfying experience. They also give simple way to achieve mathematical goal. Since mathematics is an abstract and logical science, mathematics teachers have special need for instructional materials, which tends to reality to the mathematical ideas.

Dent writes about instructional materials "All the materials used in the classroom or in the teaching situations, to facilitate the understanding of the written and spoken word is instructional materials" (Cited, Upadhyay, 2061 B.S. P. 134).

About the importance of educational materials, Upadhyay, (2061 B.S.) describes: the importance of educational materials in mathematics teaching are to motivate students towards abstract concepts, to work as a catalyst for our sensory organs, to remove verbal complexity to think out and analyze the verbal and written problems and to facilitate as a whole.

But, Risk (1947) emphasis about importance of visual materials in following ways: The use of visual materials plays an important role in mastering abstract or general concepts, visual materials are aid to thinking an abstract terms and to seeing abstract relationships. They are not helpful because we want an accurate image of thing used but because they make it easier to concentrate on or see the relationships. They thus facilitate learning because we can attend to concrete things more reality than imagined things.

Mathematics is an abstract and logical science. So the mathematics teacher at any level has a special need for instructional materials. This material implies the visual representation of different mathematical concepts. There are many kinds of instructional materials. One of the famous mathematician Rickzeh, Grossnickle divided these material into three different kinds. They are: visual, exploratory and symbolic materials. Teacher and students can use these materials in the class room situation to facilitate teaching learning process. To teach mathematics concepts or ideas to the students with help of psychological base, we should consider Piagetian learning theory. This theory is concerned with the intellectual development and age of children. The essence of this theory is "the intellectual development of children is different in different stages". According to Piaget, the intellectual development of children passes through four different age stages, sensory motor, pre-operational, concrete operational and formal operational stage. The student in lower secondary level concern to concrete operational stage (6/7-11/12 years). On this stage, they do not know about abstract concepts easily. So to teach them any mathematical concepts, concrete material should be used.

Most of the school in Nepal are still suing the traditional methods characterized by ministry of subject matter through drill, repetition and memorization. The subject matters are presented with limited teaching aids, few textbooks, chalkboard were used as the main instructional material since 1961/62. Janak Education Material Centre (JEMC) was established, which was government institution for the development, production and distribution of teaching materials for government school. Moreover, NESP-1971 has emphasized on making mathematics life oriented and practical by introducing revised content, textbooks and conducting teacher training programme and supervision system.

Mathematical teaching aids which are hundred in number generally fall into three broad categories:

i. Literature
ii. Audio, visual or audio-visual aids.
iii. Models, factor kids and manipulative materials.

In grade eight of lower secondary level curriculum, there are many areas, algebra is one of them. To teach Algebra, effectively and meaningfully as in other areas (Arithmetic and Geometry), instructional materials play a vital role. So this study was undertaken to use instructional material in teaching algebra of grade eight.

Significance of Study

The world is now running on a very exciting century. The development of technology has made tremendous impacts in all aspect of human life. Even the science of mathematics education could not stand separated from the impact of the development. The main problem of the challenging question to the mathematics educationists is how a teacher can teach and student learn mathematics effectively. The teacher can't keep contact with the students individually since there are large and crowd classes in the context of Nepal. Any traditional methods seldom use instructional materials and techniques creativity in order to support imaginative power and reasoning power of the students in the classroom teaching. The students can learn any aspect of mathematics better. If they are actually involved in learning. The instructional materials can be used in teaching activities in which all the student become active and learn more from themselves. Students cognitive power is involved while learning through instructional materials.

Realizing this fact, the researcher was attempted to conduct this study to determine the effectiveness of the use of instructional materials in teaching algebra at lower secondary level in the context of Nepal.

Statement of the Problem

This study will concern with the use of instructional materials in teaching algebra at lower secondary level. The statement of the problem are emerged as:

- Is the use of instructional materials in teaching algebra effective than without using it?
- Is the use of instructional materials in teaching algebra produce better performance?

Objective of the Study

The following are the objectives of the study:

- To find out the effectiveness of instructional materials in teaching algebra.
- To compare the achievement of the students in algebra taught by using instructional materials and not using instructional materials.

Hypothesis of the Study

The statistical hypothesis formulated to find out the answer of research question is presented below:

For the statistical test, the following hypothesis are formulated.

H_0: $\Uparrow_1 = \Uparrow_2$ (Null hypothesis)

H_1: $\Uparrow_1 | \Uparrow_2$ (Alternative hypothesis)

Where $\Uparrow_1$ and $\Uparrow_2$ are mean achievement scores of students taught by using instructional materials and not using instructional materials respectively in teaching Algebra.

Delimitation of the Study

This study is delimited in the following aspects:

- This study has been done within Nawalparasi district.

- Only the public schools are included in the study.
- The study was limited on the effectiveness of teaching algebra at grade VIII students using instructional materials.
- This study was covered only one unit "Algebraic expression" of the entire mathematics curriculum of the grade VIII and the study is based on experiment of only three weeks.

Operational Definitions

Achievement: Something that has been done or achieved through effort: a result of hard work.

Control Group:- A group in which teaching material are not provided to see the change result at post test. Teacher had used traditional method in teaching learning activities.

Effectiveness: Effectiveness is the capability of producing a desired result by students. The degrees to which objectives are achieved and the extent to which targeted problems are solved.

Experimental Group:- A group in which teaching material are provided to see the changed result at post test. Teacher himself provides the treatment to students in teaching learning activities.

Performance: A performance, in the performing arts, generally comprises an event in which a performer or group of performers present one or more work in the classroom.

Public School:- Public schools are those schools which receive the government grant for the salary of teachers and other purpose.

Student's Achievement:- Students achievement means the scores obtained by the students on the achievement test which is prepared by researcher himself.

Teaching Materials:- The actual meaning of term "teaching materials" is giving instruction in systematic schooling. In this study instrument used in teaching-learning activities for understanding of subject matter is taken as teaching materials which makes to our sense organs more active to get concept of subject matters.

Chapter II

REVIEW OF RELATED LITERATURE

Review of related literature is a deep insight and clear prospective of the overall field. The main purpose of review of related literature is to find out what works have been done in the area of the research problem under study and what has not been done in the field of the research study being under taken. It helps to conduct the new research in a systematic manner by providing the general outline of the study and avoids the necessary duplication.

Theoretical Review

Five sensory organs play an important role on children's learning when they touch, smell, hear and see, they can get new knowledge. So, educational materials play a vital role in an educational programme as learning is based primarily on sensory experiences. They also provide visual and sensory experience for the students.

The use of the term instructional materials raises a fundamental question "what are instructional materials? "In this context instructional materials are objects or things that the students are able to feel, touch, handle, and move. There may be real object which have social application in our everyday affairs. In other words, there may be several objects which are used to represent an idea. For example: number line, triangle, quadrilateral, parallelogram, charts, place value table, base ten block, geo-board, rubber band, algebraic model, set square, meter scale, abacus, flannel board, graphs, different types of geometrical shapes etc. which are to be related to the students' real world. Research in England, Japan, China and United States support the idea that mathematics instruction and students'-mathematics understanding will be more effective if instructional materials are used. In mathematics, instructional materials are defined as any materials or objects from the real world. The children move around to show a mathematical concept.

Criteria for Selecting Instructional Materials

A. Pedagogical Criteria for Selecting Instructional Materials

Pedagogically there are many criteria to consider in selecting instructional materials. One of the most important considerations is whether the instructional materials serve the purpose for which they are intended. The following criteria should be included to identify pedagogical considerations in the selection of instructional materials.

- The facilities should clearly represent the mathematical concepts.
- The facilities should be motivating.
- The facilities should be multi-purposive if possible.
- The facilities should provide a basis for abstraction.
- The facilities should provide for individual manipulation.

B. Physical Criteria for Selecting Instructional Materials

Physical criteria are important, since many sources of information available to teachers describe features of the materials. A careful watching physical criterion would be helpful in initially screening manipulating materials. Among the physical characteristics to consider in selecting instructional materials are as follows:-

Attractiveness, Durability, Simplicity, Size and Cost

The instructional materials should appeal to a child's natural curiosity and his desire for action. Instructional materials in themselves should not divert attention away from the central concept being developed. Similarly, the device must be strong enough to withstand normal use and handling by children. When maintenance is needed, it should be readily available at reasonable cost. On the other hand, the design of instructional materials shouldn't time consuming, disturbing the class, and collection of large number of facts etc. Also the instructional materials should be designed to accommodate children's physical competencies and thus be easily manipulated. Thus the cost estimate for manipulative materials should reflect the need of materials as well as the expenditure for instructional materials.

Functions of Instructional Materials

There have been several fine lists summarizing uses and functions of teaching materials. Many such lists apply specifically to instructional materials. Among the most common use of the instructional materials, some uses are as follows:

- To provide individual differences
- To provide active participation by pupils
- To provide an opportunity for students to discover relationships and formulate generalization
- To prove concrete representations of abstract ideas
- To provide experiences in actual problem solving situations
- To increase motivation related, not to a single mathematic topic, but to learning in general
- To vary instructional activities

Effective Use of Instructional Materials

Instructional materials are very important, inseparable and inevitable for the teaching of mathematics in mathematics classroom. Particularly mathematical concepts, facts and activities are found to be abstract. A teacher can use instructional materials to make his teaching easy, understandable, concrete and meaningful. Instructional materials facilitates to exchange the ideas with colleagues, evaluate the effectiveness of the materials being used, provide follow up activities, allow the students to make errors, ask the pupils questions, encourage group interaction, prepare the students to prepare themselves, prepare the classroom, prepare the students, prepare in advance for the activity, construct activities that provide multiple involvement of the concept and Consider pedagogical and physical criteria in selecting instructional materials.

Value of manipulative materials

Learning by doing is the central idea of the manipulative materials mobilization.

Research done by Cobun (1968) indicated the importance of learning with an involvement of senses. The figure briefly shows this:

Source	**learning percentage**
TASTE	1
TOUCH	1.5
SMELL	3.5
HEARING	11
SIGHT	83

Observation and research by Cobun (1968) showed that holding time as nearly constant as possible people generally remember:

10 percent of what they READ

20 percent of what they HEAR

30 percent of what they SEE

50 percent of what they HEAR and SEE

70 percent of what they SAY

90 percent of what they as they DO a thing.

The importance of visual aids can be clear from the old Chinese proverb as well

I hear I forget

I see I remember

I do I understand

It is, therefore, essential that learners should be involved, not only exposed, in the mathematical activities but also with the teaching material.

Precautions in Using manipulative materials

Some important precautions when using manipulative materials, which are discussed as follows:

- Don't use manipulative materials indiscriminately:- Care must be taken to ensure that these materials properly embody the mathematical concept being developed. Be sure the materials and concept are proportionate with your objective and the pupils level of development.
- Don't make excessive use of manipulative materials- Manipulative materials are not used only for the sake of use. They should be used in essential circumstances also.
- Don't hurry the activity and don't rush from the concrete to abstract level- While using manipulative materials, don't use them in haste. Slowly and gradually the activities should be mobilized.
- Don't provide all the answers- During the use of manipulative materials, we shouldn't provide all the answer because it brings the decreasing of creativity of the students.

Following table shows different types of teaching materials

Audio materials	**Visual materials**	**Audio/visual materials**
. Language . Radio . Sound distribution system . Tape and disco recording	. Bulleting boards . Chalk boards . Chart, Drawing . Exhibits . Fill stripes . Flash card, flannel board, magnetic board, Map, Picture, Posters, Photographs, Slides	. Demonstration . Films . Printed materials with recorded sounds .Television . Video tapes

(Adapted from Agrawal, 1996: 161)

Manipulative materials

- Geo-board
- Models
- Abacus

- Graph board
- Equation balance
- Set square
- Geo-strip etc.

Review of Empirical Studies

Empirical review means reviewing of previous studies on related topic. In this section, those studies which have been conducted previously on instructional materials on mathematics achievement are reviewed chronologically.

Sharma (2000) carried out a research on "A study on the availability and use of instructional materials in teaching mathematics at the primary schools of Parbat district Nepal" with the aim to investigate availability and use of instructional materials in teaching mathematics at the primary level. Twenty-five schools of Parbat district were randomly selected and twenty-five teachers teaching primary level mathematics were interviewed. Simple percentage reporting was applied to conclude. But the availability of the materials was not found very encouraging in most of the schools except the case of some materials such as meter scale, compass, clock model, and abacus etc.

Mitra (2001) conducted a research on "A study of teaching material and subjectwise classroom observation" with a view to investigate the availability and utilization of curriculum material in public primary schools with the research questions: how have these curriculum materials used in classroom? What have been instructional practice? The research team visited 50 classes of mathematics, social studies and Nepali. The study found that the lecture, question answer and illusion were the major approaches of teaching. The interests and ability with the emphasis shifting from teaching learning and from the teacher to one-who-makes-it possible for other to learn, it is essential that

materials are available to pupil that in all appropriates sittings: in classroom, in library in resource center, in laboratories and at home. Not only must the material be available but opportunity to use them must be provided along with the necessary encouragement and advice, remember to teacher himself can be considered an audio-visual aids of the first order. Careful integration of all aids to learning into the main system of education will enables our schools to come closure to the need of children of today.

Dhakal (2005) on his master thesis entitled "Facilities and Achievement in Mathematics of secondary level of Nepalese public school and Bhutanese refugee schools" showed that the facilities of the Bhutanese students have in Mathematics were found to be better than Nepalese students and the Bhutanese students were found to be significantly higher achiever in the mathematics than the Nepalese students at secondary level.

Karki (2006) in his study on "A comparative study of achievement in mathematics of lower secondary level students of Chhetri, Tamang and Damai caste of Lalitpur district" found that mean achievement of Chhetri students were higher than mean achievement of the students of Tamang and Damai. He also found that mean achievement of boys students were higher than mean achievement of girls students.

Ghimire (2009) conducted his study entitled "A study on the effectiveness of experimental verification in teaching the deductive proofs of geometric theorem at secondary level". The researcher studied the effect of prior use of experimental verification in proving geometric theorems and the enhancement of understanding the facts, principles and concept of geometric ideas. Post-test equivalent group design was adopted. He taught both the groups on some selected units of grade IX geometry. The experimental task was provided to experimental group only. The t-test and f-test were applied and

the results supported the conjecture that the experimental verification did have significant of teaching of geometry.

Bhushal (2010) carried out a research on "The effectiveness of teaching geometry using discovery model vs. expository model of teaching in secondary level" and his study showed that the mean achievement score of the students taught by discovery method was higher than the student taught by using expository method.

Neupane (2014) did a research on "A study on the effectiveness of play way method in mathematics teaching at primary level" with the aims to explore the effectiveness of the play way method of teaching mathematics at primary level and to compare the achievement of the students taught by play way method Vs traditional method. Pre-test, post-test equivalent group design was adopted. The researcher taught both the group for four weeks in grade one. The researcher developed the achievement test. Two schools were sampled. The t-test was applied and concluded that the play way method resulted significantly better over traditional method of teaching at primary level.

From the above literature it is found that different researches have been found on effectiveness of teaching materials. From the reviewed researches, it can be said that effectiveness of teaching materials have been found positive. No researches have been found on the effectiveness on grade VIII students. So, it is hoped that this study has tried to fulfill the gap.

After reviewing the different literature, the researcher found that there are very few researches about use of instructional materials on mathematics teaching. So to fulfill this gap the researcher motivated to select this area and developing the conceptual mapping as mentioned above in the figure.

Chapter III

METHODS AND PROCEDURES

The present study entitled "Effect of Instructional materials in teaching algebra at lower secondary level" is experimental in nature. Researcher collected quantitative data to fulfill the objective of the study. Design of the study, population and sample of the study, controlled exercise during the experiment, instrument used for data collection, validity and reliability, item analysis of the test paper, procedure of experiment are described in the following:

Design of the Study

There are many natural social (classroom) setting in which the research person can introduce something like experimental design into his scheduling of data collection procedure. Even though he lacks the full control over the scheduling of experimental stimuli (the when and whom of exposure and the ability to randomize exposures) which makes a true experimental possible. Collectively, such situation can be required as quasi experimental design. But just because full experimental control is lacking, it become imperative that the researcher be thoroughly aware of which specific variables his particular design fails to control (Cited by Upadhyay, 2001, P. 40-41). The study involved pre-test, post-test equivalent group design according to Campbell and Stenley (1969. p. 34).

The pre-test, post-test, non-equivalent group design was adopted to draw the conclusion of the study and the design of the study described in table no. 1.

Table No. 1

The Design of the Study

Groups	Pre-test	Treatment	Post-test
Experimental	T_1	X	T_2
Control	T_3	-	T_4

Where,

T_1, T_3= Pretests given to the students.

X= The treatment given to the experimental group.

T_2, T_4= Post-test given to the students.

The design of this study consists of two groups. One is experimental and other is the control group. Both schools are within the Kawasoti Resource Centre. Before selecting the experimental and control groups researcher visited the resource person and analyzed the final exam result of year 2071 of both groups at grade VII and these two groups were matched to equivalent on the basis of pretest. Before the treatment was given these two groups were given an achievement tests T_1 and T_3. In this test, sixteen questions were asked, in which 8 were of 1 marks, 5 were of 2 marks and 3 were of 4 marks (see Appendix A3). In this design, the experimental group received the experimental treatment till 20 days. But the controlled group was taught by traditional method. Finally both groups were given achievement T_2 and T_4. After taking pilot study researcher refined the achievement test papers. The achievement test paper consists of objective and subjective question according as the specification grid of grade VII published from curriculum development center, Sanothimi Bhaktapur. By using achievement test paper II, the mean, variance and standard deviation of the scores were found for both experimental and control groups. These means difference and standard deviation were compared with the help of the test statistics formula. For this, the significance of the difference in mean and standard deviation was determined with the use of t-test for the correlated data.

Field of the Study

The field of the study was grade-VIII students of selected schools of Kawasoti, Nawalparasi.

Population of the Study

All the students of grade-VIII in public lower secondary school of Nawalparasi district were the population of the study.

Sample of the Study

The researcher selected only two public lower secondary schools of Nawalparasi district. Both the schools were conducted by schools were the sample of the study. Twenty students of Gyanodaya Secondary School and Twenty Students of Shree Secondary School were selected as experimental and control groups by tossing a coin represents all the sample of the study.

Some Affecting Variables controlled in the Experiment

Different extraneous variables can affect the validity of the research activity. So, we aren't sure enough that the effect of the independent variable only on the dependent variable. This was the reason to control some variables such as maturation, history, time interval, testing effect and statistical mortality through this design of experiment. And other different variables were controlled by the following ways.

Teacher Variable

Researcher himself taught both experimental and control groups. He taught them for the same duration of time and same unit, which controls certain extraneous variables such as teacher's behaviour, teacher's qualification and other activities.

Equivalence of Experimental and Control Group

Both the schools were conducted from the same resource center and students of both schools were come from same level of society and culture. Also experimental and control group were equated with respect to the school grading. Researcher also visited the resource person of the resource center and analyzed the final exam result 2071 B.S. of the both school and it was found both could be taken as equivalent groups. By using pretest scores, researcher found correlation coefficient r_{xy}=0.73. Also the calculated t-test to check the homogeneity of the variances of both group and found that there was no significance difference between variance. And by using t-test for correlated samples and found that there is no difference between means of two groups. By these conditions researcher found that two groups are equivalent. Finally, by tossing a coin he selected one group as experimental and other group as control groups.

Teaching Methods

Researcher was used same teaching methods for both groups. He was used instructional materials only for experimental group but not for control group.

Subject Matter

Same content was taught to both the experimental and control groups from the same curriculum, same textbook prescribed by Government of Nepal.

Length of the Experiment

Researcher devoted equal time duration to teach both experimental and control groups. He taught 20 days duration in both groups by using two different techniques i.e. with using different instructional material for experimental group and without using instructional material in control group. Both groups were taught for 20 days.

Students

Both schools were situated near to each other and lie on same resource center. Both schools are similar in case of socio-economic status. There were twenty-two and twenty students on GSS and SSS respectively. Twenty students were selected for each school for experiment. For pilot study of test item, researcher selected twenty-four students of Gyanodaya Secondary School, Kawasoti.

Tools of the Qualitative Information

To get the reliable data the researcher had conducted an unstructured interview with subject teachers regarding whether the teaching materials are effective for teaching algebra. A participatory observation was made during experiment of the study.

Instruments for Experiment/Tools for Data Collection

An achievement test paper was the main instrument for data collection for the study. Some question were developed by researcher himself, some questions were taken from teacher's guide and specification grid of grade VIII which were published from CDC, Sanothimi Bhaktapur, pilot study was adopted to establish the validity and reliability of the test item (see Appendix – B). For the pilot study twenty-four items were kept. Among them eleven were objective type and thirteen items were subjective type questions. After analysis of the pilot study sixteen items were accepted and eight items were rejected.

Achievement Test Paper – I

An Achievement test paper-I contained sixteen items. Among them eight were objective item and eight were subjective items. All the questions were selected from the unit algebraic expression of grade – VIII from curriculum of lower secondary level.

Achievement Test Paper- II

The achievement test paper – II was used for both the experimental and control groups. This paper consists of only sixteen items, eight were of one mark, five were of two marks and three were of four marks. Length of the post-test was equal as the pretest. The test was administrated on the experimental and control group at the final stage of the instruction (experiment). Obtained mark of the posttest was described in Appendix (see Appendix-F).

Validity and Reliability of the Test

The school's subject teacher established the content validity of the test. To establish the ratability of the test, pilot study was administrated to 22 students of grade-VIII of Gyanodaya Secondary School on Nawalparasi district. Before administrating the test paper researcher gave instruction about how to answer the given questions. Mean time was devoted two minutes per marks. The test consisted twenty-four items, eleven were objective and thirteen were subjective. To finalize the suitable question of the test researcher used achievement score to carryout the item analysis (See Appendix-B). For item analysis 27% of upper and 27% of lower sources were identified. Also the split half reliability of the test was found 0.96. It indicates that test was reliable (see Appendix-C)

Item Analysis of the Test

For the item analysis of the test paper researcher made twenty-four items in which eleven were objective and thirteen were subjective type questions. To analyze these items researcher selected 27% upper level scores' students and 27% lower level scores' students. Out of 24 questions, each correct response was denoted by '1' and incorrect response was denoted by '0'

The difficulty level and discriminating index of two and four marks questions were separated by step wise with one mark and the average difficulty-level and discriminate index was calculated. The item analysis table

is given in Appendix (See Appendix-B) Ja.Ba.Ra. (2058, B.S.) writes: the items having (30-70%) and discriminate index above 0.20 were accepted. So that, items number 4,6,11 of one marks, item number 13, 16 and 19 of two marks and item number 22, 24 of four marks were rejected after pilot study and item no. 12 was modified. The pretest contained only eight items of one mark, five items of two marks and three item of four marks. The questions accepted and rejected are in appendix-A_2).

Specification Chart of the Test

The refined test after pilot study had only 16 items. Among them six were knowledge level, 4 comprehension level four were application level and two were skill level described in Table 2. The refined test is put in Appendix (See Appendix A2). Where item no. (1-8) were one mark item no (9-13) were of two marks and item no. (13-16) were of four marks.

Table No. 2

Level / Unit	Knowledge	Skill	Comprehension	Application
Algebra	1,3,5,7,9,12	15,17	2,10,14,20	8,18,21,23
Total	6	2	4	4

Module

To conduct experiment test, the researcher developed a teaching module for the unit "Algebraic expression" at grade- VIII mathematics curriculum. This module was developed on the basis of theoretical framework of the demonstrative approach. Detail information of the module is described in Appendix (See Appendix - D2).

The researcher adopted an achievement test on the basis of questionnaire form, observation from the related thesis that were already supervised and then the researcher formed the final schedule consulting with the experts. Content validity of instrument was maintained and continuously verified through the

consultation with expert, advisor, concerned teacher, colleagues from the beginning until the implementation of tools. Reliability of instrument was maintained by pre-testing the instrument in the similar setting.

Process of Experiment

For the experiment purpose, the researcher identified two equivalent groups of students such that both the groups were assumed to have homogenous with respect to abilities in mathematics. The researcher selected two schools as the sample of the study. Twenty students from each school were selected. The experimental group (GSS) and control group (SSS) were decided by tossing a coin.

The achievement test paper-I (pretest) was administrated on the students of grade – VIII of both schools before giving treatment. The time allocated to complete the test was given two minutes per mark i.e. one hour (The test was consisted 16 items. 8 items were objective items each of one marks other items were subjective on which 5 items were of two marks and three items were of four marks). The scores of these students were tabulated and their mean and variance were calculated by using statistical formulae. The calculation process was given in the Appendix (See Appendix- E).

After making both groups equivalent in abilities in mathematics, researcher himself taught both experimental and control groups. But the control group didn't get treatment, this group was taught traditionally by researcher himself. The researcher taught experimental group in the first period (10:15 to 11:00) and control group in the third period (11:45 to 12:30). The experiment was carried out for 20 days.

After 20 days, a posttest was administrated on the both groups. The achievement test paper-II (post test) consisted eight items of one mark, five items of two marks, three items of four marks. The duration of test was same as the pre-test. The answer sheets were marked by researcher himself. The scores

of these students were tabulated and their mean and variance were calculated by using statistical formulae (see Appendix – G).

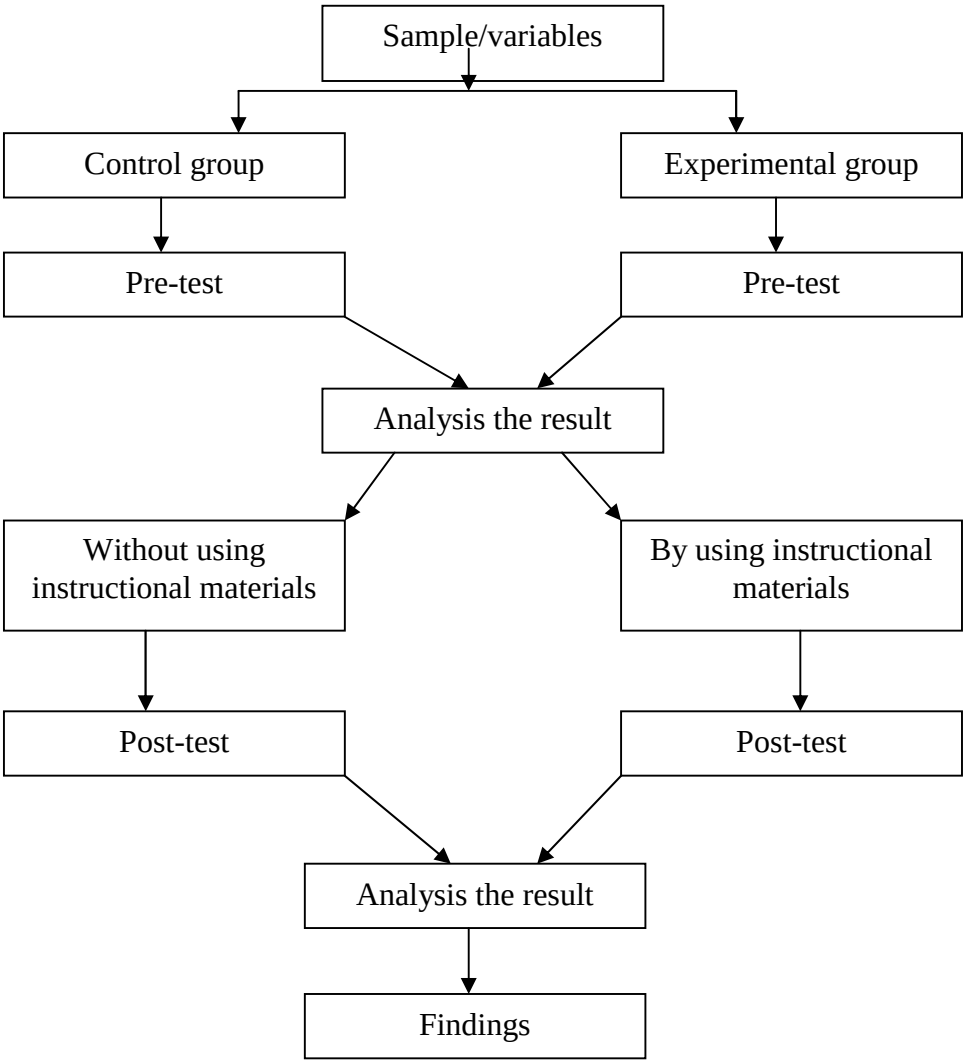
Data Analysis Procedure

The researcher analyzed and interpreted the collected data in following procedure:

- Mean standard deviation and variance were calculated for both groups with their secured marks in the test.
- t-test for independent samples were used at 0.01 level of significance to find whether the difference between means is statistically significant by using the method of pooled variances formulae as given in Appendix-G.
- When the samples are small and their variance are equal nearly we can use method of pooled variance to test the significance difference between two independent means, the critical value of t-test be found for N_1+N_2-2 degree of freedom.
- Homogeneity of variance (f) was tested by using the statistical formula given in Appendix-G.

Procedural Framework

The procedural framework, which illustrates the all process of study has been presented as following:



From the given framework of the study it is clear that equal number of students are taken for as control group and experimental group. Both groups were pre-tested and the results have been analyzed. From the result of the students using instructional materials and without using instructional materials, they were again tested. Then the result have been analyzed and findings have been drawn.

Chapter- IV

ANALYSIS AND INTERPRETATION OF DATA

The researcher was experimental in nature. The achievement test was the basic tool for data collection to achieve the result for the objectives. Twenty students from each school were selected. Research was intended to explore the effectiveness of the instructional materials in teaching Algebra. The collected data in this study were analyzed in the following headings:

Comparison of Achievement between the Experimental and Control Groups

In this study, twenty students each from experimental and control group have been taken for the study to found out whether there is effectiveness of instructional materials on teaching algebra or not.

Analysis of Pretest Result

Score of the pretest of the students of the experimental and control groups are presented in Appendix E and the statistical calculation of the pretest of both the group are presented in table 3.

Table No. 3

Comparison of Pretest Results

Groups	N	$\overline{X}$	∃	$\exists^2$	ℑ	F-value	t-value
Experimental	20	8.55	5.14	26.24	0.01	1.57	0.13
Control	20	7.65	4.10	16.8			

The means, variances and the standard deviations of the scores on pretest result of experimental and control groups are 8.55, 26.24, 5.14 and 7.65, 16.8, 4.10 respectively as shown in above table.

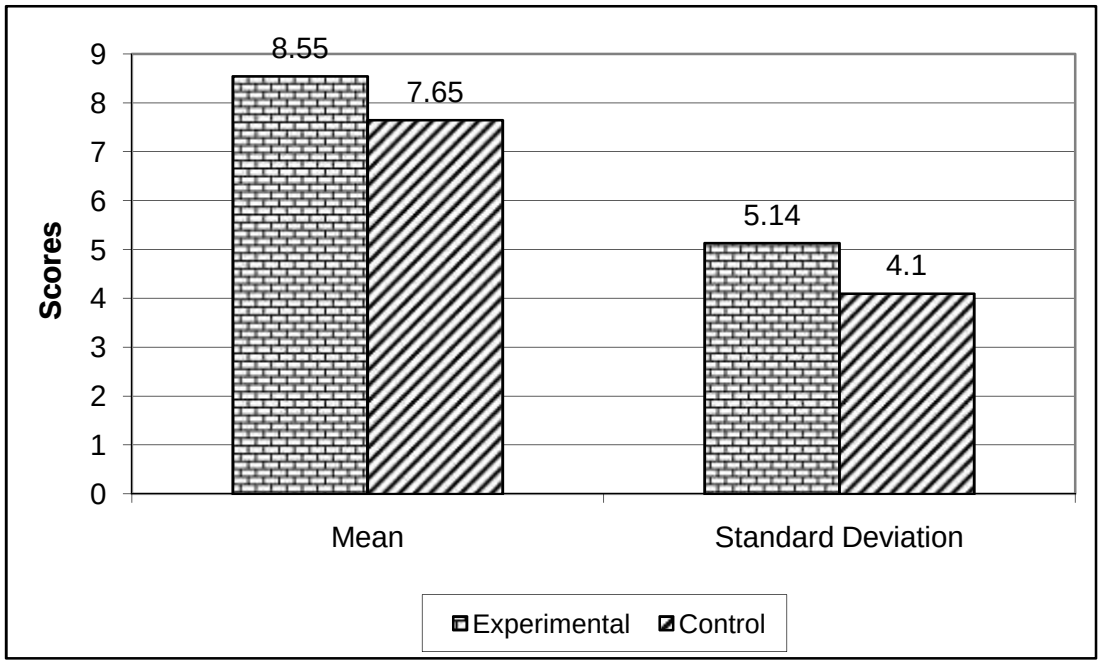
In order to test the null hypothesis of this study, the researcher established two equivalent groups of students on the basis of coin tossing. Pretest was taken as the purpose to establish the homogeneity of experimental group and control groups. The other purpose of pre-test was to check out these groups were equivalent. The researcher found the correlation coefficient between these two groups by using Pearson's method, whose formula is given in Appendix (See Appendix-G). The researcher found the correlation coefficient r_{xy}= 0.73, According to Best and Khan (2002) the correlation between the experimental and the control group is substantial.

Homogeneity of the Variances

To test the homogeneity of the variances, researcher calculates value of f. The calculated value f = 1.57 is less than the tabulated value of F (F = 2.88) indicates that the variance are homogeneous to each other. Statistical formulae are descried in Appendix (See Appendix G)

Figure no. 1

Comparative Bar Graph showing Achievement of Experimental and Control Group in Pretest in Algebra



Whether initial difference existed between two groups, the t-test for correlated samples were used to find out the value of t. The t-value (t = 0.13) in above table no.3, which was less than the tabulated value, 2.57. So the null hypothesis is accepted. Therefore there is no difference in the means of two groups and thus both groups are taken as equivalent.

The figure 1 also shows the mean and standard deviation scores obtained from both experimental and control groups in pre-test. The diagram indicates that there is no significant difference between mean and standard deviation obtained from achievement scores in algebra of both groups.

Analysis of Post-test Result

The post-test was administrated to both experimental and control group after the treatment was given. The post-test scores of students of experimental and control group are presented in Appendix-'F' and the summary of the statistical calculation for both groups is presented in the table 4.

Table No. 4

Comparison of post-test Scores

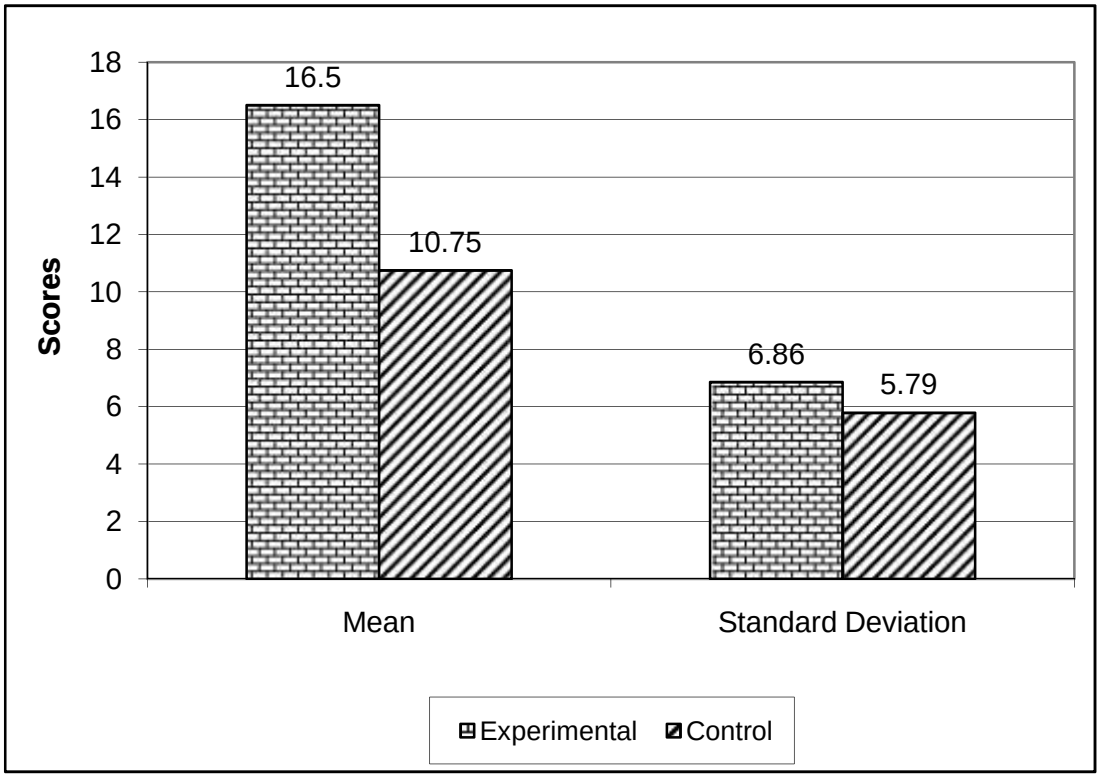
Groups	N	$\overline{X}$	∃	t-value	ℑ
Experimental	20	16.50	6.86	2.86	0.01
Control	20	10.75	5.79		

The table no. 4 indicates that both mean and standard deviation of both groups are different. The score of experimental group ranged from seven to twenty eight with mean score 16.50 and scores of control group ranged from five to twenty five with mean scorer 10.75 and standard deviation are 6.86 and 5.79 respectively.

In order to see whether initial difference is existed between two groups; t-test was employed with 0.01 level of significance. On table 4 the calculated value 2.86 is greater than the critical value i.e. tabulated value 2.57 at 0.01 level of significance. Therefore, the null hypothesis, there is no significant difference between two means of experimental and control group students, is rejected and the alternative hypothesis is accepted. This indicates that the students of experimental group are significantly benefited in the achievement of algebra than the students of control group. Thus, the researcher conclude that the achievement of the grade VIII students. Who were taught algebra with using instructional materials, achieved better achievement than the students who were taught without using instructional materials.

Figure No. 2

Comparative Bar Diagram Showing Achievement of Experimental and Control Groups on Post-Test in Algebra



The above figure 2 shows that the mean and standard deviation scores obtained by the students of experimental and control group. In the post-test, the

mean score of experimental group is 16.50 and control group is 10.75. Therefore, the mean score of experimental group is greater than the control group and the standard deviation of experimental group is also greater than the control group. This result indicates that the experimental group has better result than the control group. Hence the achievements of the students taught by using instructional materials is better than the achievement of the students taught without using instructional materials.

Qualitative Information

From the survey, teachers said that instructional materials are essential elements in teaching learning process. They opined that without use of these teaching materials, teaching learning process becomes incomplete and handicapped. When a teacher teaches mathematics by using materials then he can achieve the objectives. Without applying instructional materials, teaching learning process can not be effective. Teacher should have knowledge of using teaching material in the classroom. Many materials are available in our locality. Most of our primary mathematics teachers have no knowledge of using these materials. So it is necessary to train primary teacher to provide the knowledge of collecting, constructing and using instructional materials.

From the survey, the teachers are highly positive that implementation of manipulative materials provides children with opportunities to explore ideas and to find the ways for solving problems. In the process of manipulation, they may well find various kinds of mathematical relationships. Instructional materials, in the form of games provides opportunities not only for practicing and reinforcing skills learnt, but also for applying the concept and principles.

The mathematics teachers were agreed that teaching is a specialized skill that's why it requires various sorts of instruments and skills to handle it. Similarly, materials are required for effective teaching. Local materials can also be used for constructing the instructional materials that can be used for teaching mathematics. There are various types of instructional materials; some

of them are readymade, expensive and wonderful. Instead of these, use of local materials are very important because they are well known for student and teacher and these are constructing locally, using all local things. They pointed out that the main problem of learning mathematics is, it is generally accepted as a complex subject. Due to the cause of feeling hardness, most of the students fail in exam at any level of many times. We can see the result of SLC exam. It is not occurred as we think. Many pupil drooped from the education due to failure in exam, which is caused by mathematics. They opined "We can not minimize the fail percentage in mathematics; such types of series questions are in mathematics education." On other hand, the important of mathematics education is universal. We can't underestimate of its importance in daily life situation of this reality.

From the above mentioned problem, it can be realized that the value and significance of instructional material, various kinds of researches can be conducted how the children acquire the mathematical concept.

The teachers said that there are many abstract mathematical concepts, which cannot be thought meaningfully without use of instructional materials. We should relate these mathematical concepts, skills and facts to enhance mental power of child with the help of the instructional materials. Lower secondary level mathematics is the base for further level of mathematics so it is necessary to built up true knowledge and concept on the topic related to this level.

Finally, the teachers pointed out that the importance of instructional materials are as follows:

- It reduces the teaching load of teacher.
- It makes teaching learning activities lively
- It helps to understand the abstract concept of mathematics.
- It increased the amount of student understanding.
- It helps to involve the students directly in teaching learning activities.

- It arouses the interest of the student to the teaching learning activities.

Improving Mathematics Teaching by Using Manipulative Materials

During survey period, teachers are seemed always interested in looking for ways to improve their teaching and to help students to understand mathematics. Teaching materials support the idea that mathematics instruction and student mathematics understanding was found more effective. From this it can be said that mathematics manipulative is defined as any material or object from the real world that children move around to show a mathematics concept.

Teachers were agreed on manipulative materials in teaching mathematics to students hold the promise that manipulative helps students understand mathematics. At the same time as with any "cure", manipulative hold potential for harm if they are used poorly. They said that manipulative are improperly used will convince students that two mathematical worlds exists - manipulative and symbolic. All mathematics comes from the real world. Then the real situation must be translated into the symbolism of mathematics for calculating. For example, putting three goats to get eight goats in the real world situation but on the mathematics level we say 3+5=8 (Read three add five equals eight). They said that these are not two different worlds but they are in same world expressing the concept in different ways.

The teachers suggested that the manipulative materials should relate to the students' real world. They had also give an example that the use of an abacus is not something that is used in Malawian daily life; instead stones, eating utensils, tins, beans, apples, peanuts, sticks, etc. would be more appropriate.

Teachers focused that each student needs material to manipulate independently. Demonstration by the teacher or by one student is not sufficient. With students actively involved in manipulating material, interest in mathematics will be aroused. Manipulative materials must be selected that are appropriate for the concept being developed and appropriate for the developmental level of the students. For example, one stick may be placed on a

place value chart in the ones place. However, one stick shouldn't be placed in the tens place. Instead a package of ten sticks bundled together with string or an elastic should be placed in the tens place.

The teachers gave the example that the same is true for the concept of the hundreds place; a bundle of 100 identical things should be used. As the students' concept of place value develops, then singles sticks can be used for place value of numbers with greater value.

Teachers said that good mathematics manipulative materials are durable, simplistic (easily manipulated), attractive (to create interest), and manageable. A systematic method should be developed for storage and distribution purposes.

They pointed out that using manipulative materials in teaching mathematics will help students learn:

- to relate real world situation to mathematics symbolism.
- to work together co-operatively in solving problems.
- to discuss mathematical ideas and concepts.
- to verbalize their mathematical thinking.
- that there are many different ways to solve problems.
- that mathematics problems can be symbolized in many different ways.
- that they can solve mathematics problems without just following teachers' directions.

Mathematics teachers from the selected schools taught using manipulative materials, then the methods of evaluating mathematical achievement must also change. Just calculating correct solutions to mathematics problem is not sufficient. Concept development and understandings should be valued more highly. Effective use of mathematics manipulative contributes to conceptualize and understanding. Evaluation of students' mathematics is changing from tests and testing to assessment. Assessment is much broader than testing or evaluation. For teachers to asses' students' understanding of concepts, different techniques of evaluation is

needed. Mathematics teachers said that they received more insight into students' mathematics understanding by:

- Listening to students' talk about their mathematics thinking.
- Observing students working individually and in co-operative groups.
- Asking why and how questions rather than asking:

a. Yes or no questions.
b. For results of calculating activities.
c. For answers.

- having students write a solution to a problem rather than by only responding with correct or incorrect values.

From the survey, paper-and-pencil method of assessment limits the scope of student's evaluation. Requiring students to defend their mathematical reasoning provides insight into the development of the student's functioning within a group provided data for assessment. The teachers moved around the classroom observing how students are working and interacting.

Chapter V

SUMMARY, CONCLUSION AND RECOMMENDATIONS

After the analysis and interpretation of the collected data, an attempt has been made to summarize to enlist the findings and some recommendations for further study. The first section of this chapter presents the summary of the study, the second section presents its findings and the last section presents recommendations based on the findings of the study.

Summary of the Study

This study was concerned with the study of effectiveness of teaching algebra by using instructional materials at lower secondary level. For this study, the researcher developed test items with the help of prescribed curriculum and the textbook of mathematics of grade eight. He administrated the test in Gyanodaya Secondary School for the purpose of piloting. Test paper was the main instruments used for the study.

For this study, the researcher selected Gyanodaya Secondary School, and Shree Secondary School for experimental and control group by tossing a coin. Each group had contained 20 students. At first pre-test was administered on both groups. Then the experimental group was taught by using instructional materials and the control group was taught without using materials. The scores were analyzed by using the mean, variance and t-test for independent samples.

Findings

Based on the analysis of quantitative and qualitative data, following findings have been drawn:

- The researcher found the correlation coefficient r_{xy}= 0.73.
- The calculated value f = 1.57 is less than the tabulated value of F (F = 2.88) indicates that the variance are homogeneous to each other.

- The t-value which was less than the tabulated value, 2.57. So, there is no difference in the means of two groups and thus both groups are taken as equivalent.
- The score of experimental group ranged from seven to twenty eight with mean score 16.50 and scores of control group ranged from five to twenty five with mean scorer 10.75 and standard deviation are 6.86 and 5.79.
- The researcher conclude that the achievement of the grade VIII students. Who were taught algebra with using instructional materials, achieved better achievement than the students who were taught without using instructional materials.
- The teachers opined that without use of these teaching materials, teaching learning process becomes incomplete and handicapped.
- The teachers are highly positive that implementation of manipulative materials provides children with opportunities to explore ideas and to find the ways for solving problems.
- The teachers suggested that the value and significance of instructional material, various kinds of researches can be conducted how the children acquire the mathematical concept.
- Teachers were agreed on manipulative materials in teaching mathematics to students hold the promise that manipulative helps students understand mathematics.
- Manipulative materials must be selected that are appropriate for the concept being developed and appropriate for the developmental level of the students. For example, one stick may be placed on a place value chart in the ones place.
- Teachers said that good mathematics manipulative materials are durable, simplistic (easily manipulated), attractive (to create interest), and manageable. A systematic method should be developed for storage and distribution purposes.

Conclusion

The students of experimental group are significantly benefited in the achievement of algebra than the students of control group. Thus, it is concluded that the achievement of the grade VIII students. Who were taught algebra with using instructional materials, achieved better achievement than the students who were taught without using instructional materials. The mean score of experimental group is greater than the control group and the standard deviation of experimental group is also greater than the control group. This result indicates that the experimental group has better result than the control group. From this, it is concluded that the achievements of the students taught by using instructional materials is better than the achievement of the students taught without using instructional materials.

Recommendation

From the findings and conclusions drawn from this study the researcher suggested the following recommendations:

1. Each teacher should give the basic concept of Algebra with the help of factor kids.
2. When a person writes a textbook and teacher guide, he has to show the pictorial method as a problem solving method.
3. To teach algebraic expression in school factors kids should be used.
4. A similar study can be carried out in other branches of school mathematics.
5. Similar studies including the opinions and attitudes of parents', teachers' and students' should be carried out.
6. The teachers, students, textbook writers, syllabus designers and methodologist can modify their views or approach in the light of the information provided.

BIBLIOGRAPHY

Amatya, B. P. (1978). *Study of effectiveness of teaching mathematics with and without use of instructional materials,* Master Degree Thesis, T.U., Kirtipur.

Best, J. W. and Kahn, J. V. (2002). *Research in education* (7th edition). New Delhi: Prentice Hall of India.

Bhusal, I. P. (2010). *A study of effectiveness of teaching geometry using discovery and expository methods.* Kirtipur: Master Degree Thesis.

Cobun, H. (1968). *Importance of Learning with an Involvement of Sense*. A Research Report Submitted to Oxford University, Lonodn: OUP.

David, F; Dorothy, G. and Rosamoud, T. (1995). *The Van Hiele model of thinking in geometry among adolescents.* New York: University of New York.

Dhakal P. P. (2005). *Facilities and achievement in mathematics of secondary level students of Nepalese public school and Bhutanese refugee school*. Masters Thesis, T.U., Kirtipur.

Edith, E. B. & James, R. M. (1969). *Freedom to learn: An active learning approach to mathematic*. Addison: Wesley Ltd.

Freund, J. E. (2002). *Mathematical statistics* (6th Edition). New Delhi: Pearson Education Pvt. Ltd, India.

Ghimire, R. P. (2009). *A study on the effectiveness of experimental verification in teaching the deductive proofs of geometric theorem at secondary level*. Master Degree Thesis, T.U., Kirtipur.

Howson A. G. (1973). *Development in mathematics education*. Cambridge: Cambridge University Press.

Jabara, S. P. (2001.). *Theory and practice of measurement and evaluation.* Kathmandu: Biddharthi Pustak Bhandar.

Karki, R. (2006). *A comparative study on achievement in mathematics of lower secondary level students of Chhetri, Tamang and Damai caste of Lalitpur district.* Master's Degree Thesis, Faculty of Education, T.U.

Khanal, P. (2003). *Research methodology.* Kathmandu: Students Books Centre.

Maskey, S. M. (1975). *A comparative study of mathematics achievement of primary school students under different class size.* Kirtipur: Masters Thesis, Institute of Education, T.U.

Mitra, (2001). *A study on teaching materials and subject-wise classroom observation, research study*. Kathmandu: HMG.

MOES (1996). *Teachers guide of mathematics of grade-V.* Bhaktapur, CDC, HMG, MOES.

MOES (1999). *Specification grid of grade-V.* Bhaktapur: Curriculum Development Centre.

MOES (2004) *Mathematics textbook of grade-V.* Bhaktapur, CDC, HMG, MOEs.

Neupane, B. (2014). *A study on the effectiveness of play way method in mathematics teaching at primary level*. Kathmandu: Mahendra Ratna Campus, Tahachal.

Rai, B. C. (1978). *Method of teaching mathematics.* Lucknow: Prakashan Kendra.

Risk, T. M. (1947). *Principle and practice of teaching in secondary school.* Audio-Visual Aids, New Delhi: Eurasia a Publishing House.

Sidh, K. S. (1984). *Teaching of mathematics.* New Delhi: Sterling Publisher Pvt. Ltd.

UNESCO (1989). *Studies in mathematics education.* Vol.5, Geometry in Schools, UNESCO.

Upadhyay, H. P. (2001). *Effect of constructivism of mathematics achievement of grade-V student in Nepal dissertation.* Chandigarh, India: Punjab University.

Upadhyay, H. P. (2003). *Theses abstract (In mathematics education).* Kathmandu: Kshitiz Prakashan, Kirtipur.

Upadhyay, H. P. (2004 B.S.). *Teaching mathematics.* Kathmandu: Ratna Pustak Bhandar.

Appendix – B

Item analysis of the Test

Student / Item	Upper 27% student giving correct response							Lower 27% student giving correct response									Rem.
	1	2	3	4	5	6	Total	1	2	3	4	5	6	Total	P%	D	
1	1	1	1	0	0	1	4	1	0	0	0	0	0	1	42	0.50	
2	1	1	0	1	1	1	5	1	0	1	0	0	0	2	58	0.50	
3	1	0	0	1	1	1	4	0	1	0	1	0	0	2	50	0.33	
4	1	1	1	1	1	0	5	1	1	1	0	0	1	4	72	0.16	Rejected
5	0	1	1	1	1	0	4	1	0	0	0	0	0	1	2	0.50	
6	1	0	0	0	0	0	1	0	0	0	0	0	0	0	16	0.16	Rejected
7	1	1	1	1	0	1	5	0	1	0	0	0	0	1	50	0.66	
8	1	1	1	1	1	1	6	1	0	0	0	0	0	1	42	0.83	
9	1	0	0	1	1	1	4	0	0	0	0	1	0	1	42	0.50	
10	1	1	0	1	0	1	4	0	1	1	0	0	0	2	50	0.33	
11	0	0	0	1	0	0	1	0	0	0	1	0	0	1	16	0	Rejected
12	1	1	1	1	1	1	6	1	1	1	1	0	1	5	92	0.17	
	0	1	1	1	1	1	5	1	1	1	0	0	0	3	67	0.33	
															80	0.25	Modified
13	1	1	1	1	1	1	6	1	1	1	1	1	0	5	91	0.17	
	1	1	1	1	0	1	5	1	1	1	0	1	0	4	75	0.17	
															83	0.17	Rejected
14	1	1	1	1	1	1	6	1	0	0	0	0	0	1	58	0.83	
	1	1	0	1	1	1	5	0	0	0	1	0	0	1	50	0.66	
															54	0.74	
15	1	1	1	1	1	0	5	1	0	1	0	0	0	2	82	0.17	
	1	0	0	1	1	1	4	0	1	0	0	0	0	1	59	0.17	
															76	0.17	
16	1	1	1	1	1	1	6	1	1	1	0	1	1	5	92	0.17	
	1	0	1	1	1	0	4	0	1	0	0	1	1	3	59	0.17	
															76	0.17	Rejected
17	1	1	1	0	1	0	4	0	0	0	0	0	0	0	33	0.66	
	0	1	1	1	0	0	3	0	0	1	0	0	0	1	33	0.33	
															33	0.50	
18	1	1	1	1	0	1	5	1	0	0	0	0	1	2	58	0.50	
	1	0	1	1	0	0	3	0	1	0	0	0	0	1	33	0.33	
															46	0.42	
19	1	1	1	0	0	0	3	1	0	0	0	0	1	2	42	0.17	
	0	1	0	0	0	0	1	0	1	0	0	0	0	1	17	0	
															30	0.08	Rejected
20	1	1	0	1	1	1	5	0	1	0	0	0	0	1	50	0.67	
	1	1	1	1	1	0	5	0	0	0	1	0	0	1	50	0.67	
	1	0	0	0	1	1	3	0	0	0	0	0	0	0	25	0.50	
	1	1	0	0	0	0	2	0	0	0	0	0	0	0	17	0.33	
															36	0.54	

21		1	1	1	1	1	1	6	1	1	0	0	0	0	2	67	0.67	
		1	1	0	1	1	0	4	0	0	1	0	0	0	1	42	0.50	
		0	0	1	0	1	1	3	0	0	0	0	0	0	0	25	0.50	
		0	1	0	1	0	0	2	0	0	0	0	0	0	0	27	0.33	
																38	0.50	
22		1	1	1	1	1	1	6	0	0	0	0	0	0	0	17	0.33	
		0	1	0	0	0	0	1	0	0	0	0	0	0	0	8	0.17	
		1	0	0	0	0	0	1	0	0	0	0	0	0	0	8	0.17	
		1	0	0	0	0	0	1	0	0	0	0	0	0	0	8	0.17	
																10	0.21	Rejected
23		1	1	1	1	1	0	5	0	0	0	1	1	0	2	58	0.50	
		1	1	0	1	0	1	4	1	0	1	0	0	0	2	50	0.33	
		0	0	0	1	1	1	3	0	0	0	0	0	0	0	25	0.50	
		1	1	1	0	0	0	3	1	0	0	0	0	0	1	25	0.50	
																40	0.46	
24		1	1	1	1	1	1	6	1	0	0	1	1	1	4	83	0.33	
		1	1	1	1	1	1	6	0	1	1	1	1	1	5	92	0.16	
		1	1	0	1	1	1	5	0	0	1	0	1	1	3	67	0.33	
		0	1	1	1	0	1	4	1	0	0	1	1	0	3	75	0.16	
																80	0.25	Rejected
Sum	Odd	15	16	13	16	12	11		9	7	6	4	4	1				
	Even	22	19	14	19	16	16		10	9	8	6	6	8				
	Total	37	35	27	35	28	27		19	16	14	10	10	9				

Appendix – C

(Split half reliability of the test)

Students	Odd (x)	Even (y)	x.y.	X^2	y^2
1	15	22	330	225	484
2	16	19	304	256	361
3	13	14	182	169	196
4	16	19	304	256	361
5	12	16	192	144	256
6	11	16	176	121	256
7	9	10	90	81	100
8	7	9	63	49	81
9	6	8	48	36	64
10	4	6	24	16	36
11	4	6	24	16	36
12	1	8	8	1	64
N= 12					

Reliability of split half test, $r_{xy} = \frac{N\phi xy \; Z\phi x.\phi y}{\sqrt{\phi x^2 \; Z(\phi x)^2}.\sqrt{\phi y^2 \; Z(\phi y)^2}}$

$= 0.93$

Therefore, reliability of whole test $(r_{tt}) = \frac{2r_{xy}}{1 \Gamma r_{xy}} X \frac{2 \mid 0.93}{1.93} = 0.96.$

Appendix -D_1

Model of Lesson Plan Based on Conventional Method

For Control Group

School: Date:

Subject: Mathematics Time : 45 Mins

Unit : Algebraic expression Class: 8

Topic: Squares of Polynomials

1. Specific objective

After the completion of this lesson the students will be able to:

a. Derive (a+b)2 = a2+2ab+b2)

b. Apply the formula to solve related problem.

1. Teaching Aids.

Daily used materials.

2. Teaching Learning Activities:

Reviewing the previous lesson, today's lesson follows the following activities:

Reviewing the previous lesson, the teacher will clarify the extension of $(a+x)^2=a^2+2ab+b^2$, $(a-b)^2= a^2-2ab+b^2$ by using the different teaching methods: problem solving, discussion, demonstration respectively.

4. Evaluation :

a. What is the extension of $(a+b)^2$?
b. Simplify $(2x+3)^2$ applying the formula, $(a+b)^2$.

5. Homework:

Do the followings

a. $(a+b)^2$ b. If $x+\frac{1}{x}$ X3 find the value of $x^2+\frac{1}{x^2}$ X?

c. $(a^2b+b^2c)^2$ d. Simplify: $(2x+5)^2 + (6x+3)^2$

Appendix D_2

Lesson Based on the Used of Models (For Experiment Group)

Lesson Plan No. 1

School: Date:

Subject: Mathematics Time : 45 Mins

Unit : Algebraic expression Class: 8

Topic: Different of Two Squares

1. Specific objective:

After the completion of this lesson the students will be able to

a. Define $a^2-b^2=(a+b)(a-b)$
b. Apply the formula to solve related problem.

2. Teaching materials:

Daily used materials and different models having area of a^2 & b^2.

3. Teaching learning activities:

During the class period the teacher will do the following activities.

a. To show the extensive form of (a^2-b^2) showing pieces of a^2 & b^2 the teacher will conduct the following activities using the different teaching methods: problem solving, discussion and demonstration respectively.

Activity No. 1

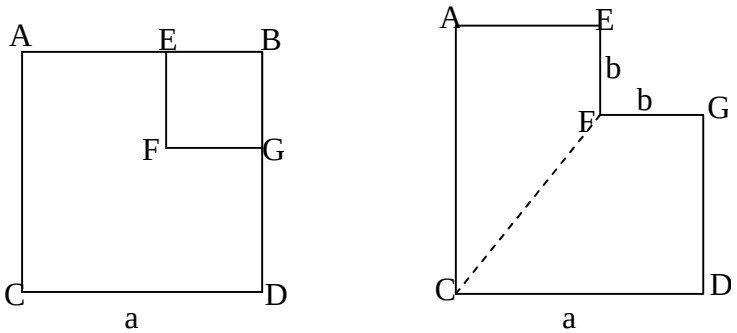


Fig. No. 1

Area of ABCD = a^2

Area of EFGB = b^2

Activity No. 2

Area of ADGE = (a+b) (a-b)

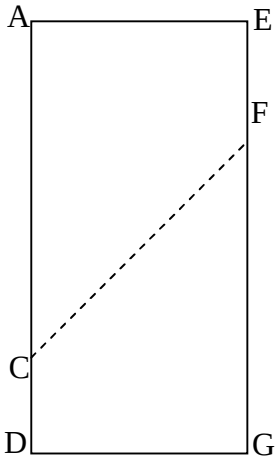


Fig. No. 2

4. Evaluation

a. What is the extension of $(a+b)^2$

b. Simplify: $(2x)^2-9$

5. Homework

Do the following

a) $a^2-\frac{1}{a^2}$ b) p^2-25q^2 c. $25x^2-(3x+1)^2$

Lesson Plan No. 2

School: Date:

Subject: Mathematics Time : 45 Mins

Unit: Algebraic expression Class: 8

Topic: Different of Two Squares

1. Specific objective:

After the completion of this lesson the students will be able to

a. Show $a^2-b^2= (a+b) (a-b)$

b. Apply the formula to solve related problem.

2. Teaching materials:

Daily used materials and different models having area of a^2-b^2 and ab.

3. Teaching learning Activities:

Reminding the previous lesson to the students, the teacher completes the new lesson conducting the following different activities:

a. to show the extensive form of $(a+b)^2$ showing the different pieces of wood having areas of a^2, b^2 and ab, the teacher will conduct the following activities using different teaching methods: Problem solving, discussion and demonstration respectively.

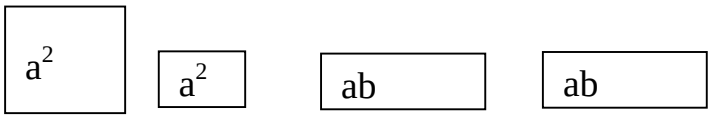
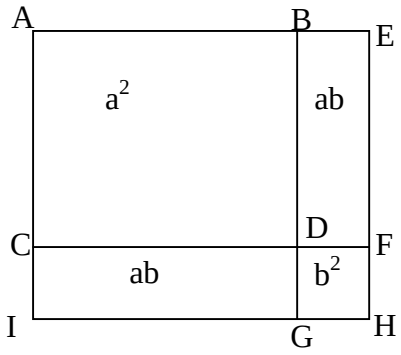


Fig.1 Fig.2 Fig.3 Fig.4

Area of figure no. 1,2,3,4 are a^2, b^2 ab, ab



Area of AEHI = Ar. ABDC + Ar. CDGI + Ar. DGHF + AR. BDFE

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

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

b. To make clear the students, makes different models of other expression having $(a+b)^2$

$(3x)^2$	3x x 2y
2x x 3y	$(2y)^2$

In this figure $9x^2+6xy+6xy+4y^2$

$= 9x^2+12xy+4y^2$

4. Evaluation:

a. What is the extension of $(a+b)^2$?

b. Simplify: $(2x + 3)^2$ applying the formula, $(a+b)^2$.

5. Homework:

Do the following

a. $(a+b)^2$ b. If $x + \frac{1}{x} = 3$ find the value of $x^2 - \frac{1}{x^2}$ X?

c. $(a^2b+b^2c)^2$ d. Simplify : $(2x+5)^2 + (6x+3)^2$

Lesson Plan No. 3

School: Date:

Subject: Mathematics Time : 45 Mins

Unit : Algebraic expression Class: 8

Topic: Different of Two Squares

1. Specific objective:

After the completion of this lesson the students will be able to

a. Derive $(a-b)^2 = a^2-2ab+b^2$
b. Apply the formula to solve related problem.

2. Teaching materials:

Daily used materials and different models having area of a^2, b^2 and ab.

3. Teaching learning activities:

Reminding the previous lesson to the students the teacher. Complete the new lesson conducting the following different activities.

a. To show the extensive from of $(a-b)^2$, showing the different pieces of wood having area a^2, b^2 and ab the teacher will conduct the following activities using different teaching methods: problem solving, discussion and demonstration respectively.

Activity No. 1

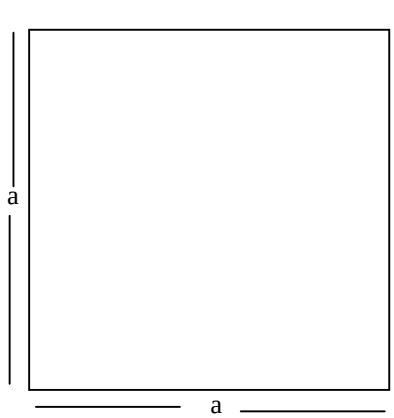


Figure No. 1

Activity No. 2

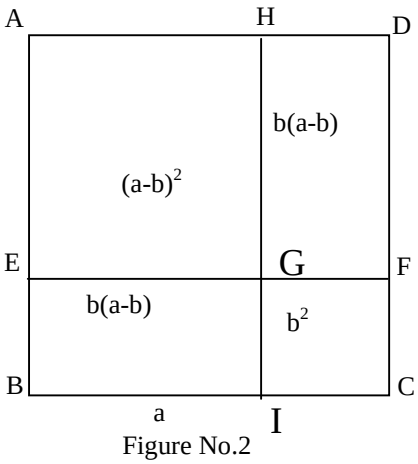


Figure No.2

Area of Figure no. 1 = a^2

Area of figure no. 2 ABCD = Area of (AEGH+GHDF+BEGI+GICF)

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

…$(a-b)^2 = a^2-2ab+b^2$

b. To make clear the students make different models of other expression having $(a-b)^2$.

4. Evaluation

a. What is the extension of $(a-b)^2$.

b. Simplify $(2y-1)^2$ applying the formula $(a-b)^2$.

5. Homework:

a. Simplify: $(2a-1)^2$ b. If $x-\frac{1}{x}X3$, find $x^2+\frac{1}{x^2}X$?

c. Expand: $(a^2b-c^2c)^2$ d. Simplify: $(2x-5)^2 + (6x-3)^2$

Lesson Plan No. 4

School: Date:

Subject: Mathematics Time : 45 Mins

Unit : Algebraic expression Class: 8

Topic: Factorization of trinomials of the type px^2+qx+r .

1. Specific objective

After the completion of this lesson the students will be able to:

a. Factorization of trinomials forms px^2+qx+r

2. Teaching materials

Dairy used materials and different models having x^2, x and unit.

3. Teaching learning activities

During the class period the teacher will do the following activities.

a. To show the extensive form px^2+qx+r, showing the different pieces of wood having area x^2, x and unit, the teacher will conduct the following activities using different teaching methods: Problem solving, discussion and demonstration respectively.

Ex: x^2+5x+6

Activity No. 1

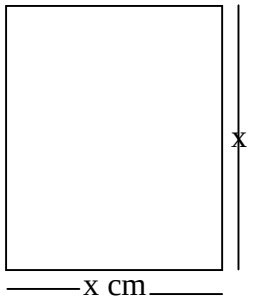


Figure No. 1

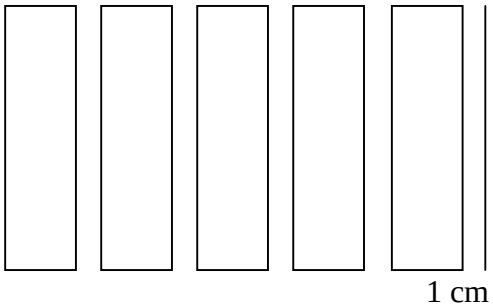


Figure No. 2

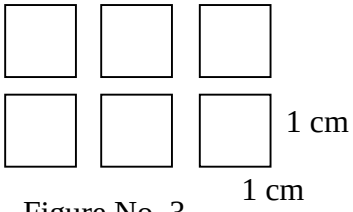


Figure No. 3

Here, Area of figure no. 1=x^2

Area of figure no. 2= x x 1=X

Area of figure no. 3= 1x1=1

In the above pieces of wood construct the rectangle.

Activity No. 2:

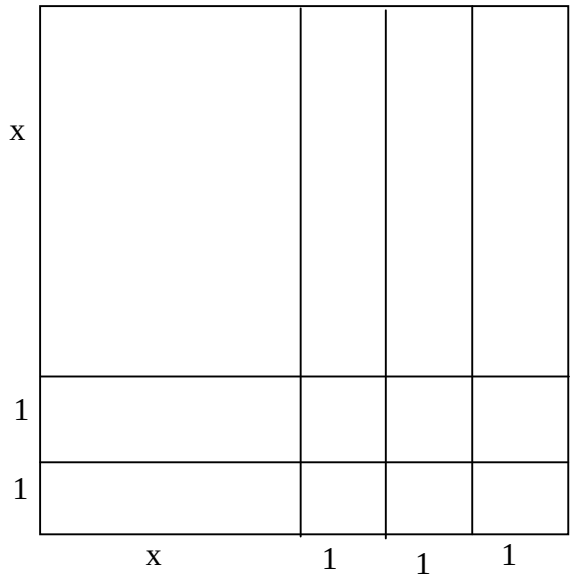


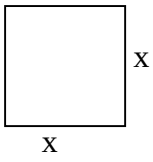
Figure No. 4

Are of above figure no. 4 = (x+2) x (x+3)

…We conclude that $x^2+5x+6 = (x+2) \times (x+3)$

b. To make clear the students make different models of another factorization.

4. Evaluation:



What is the area of this figure?

Evaluation is embedded within the activities.

5. Homework:

Do the following:

a. $x^2+7x+12$ b. x^2+4x-3

c. $5p^2+18pq+9q^2$ d. $4x^2+5x-1$

Lesson Plan No. 5

School: Date:

Subject: Mathematics Time : 45 Mins

Unit : Algebraic expression Class: 8

Topic: Factorization of trinomials of the type px^2+qx+r .

1. Specific objective

After the completion of this lesson the students will be able to:

a. Factorize of trinomial forms of px^2-qx-r

2. Teaching materials:

Daily used materials and different models having x^2, -x, +x & unit .

3. Teaching learning activities:

During the class period the teacher will do the following activities.

a. To show the extensive form px^2-qx-r, showing the different pieces of wood having area x^2, x –x & unit the teacher will conduct the following activities using different teaching methods: questionnaire, discussion and demonstration respectively.

Ex: Factorized x^2-x-6

Activity No. 1

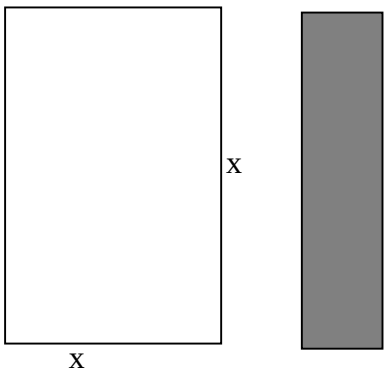


Figure No. 1

Figure No. 2

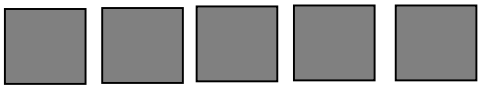


Figure No. 3

Area of figure no. 1 = x^2

Area of Figure no. 2 = -x

Area of figure no. 3 = -1

Activity no. 2

An attempt was made to construct the rectangle using above pieces.

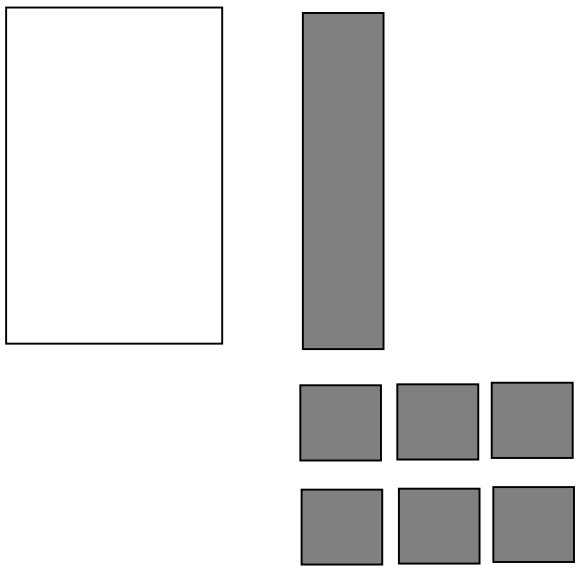


Figure No. 4

Activity no. 3

Here, above figure complete the rectangle add +2x & -2x

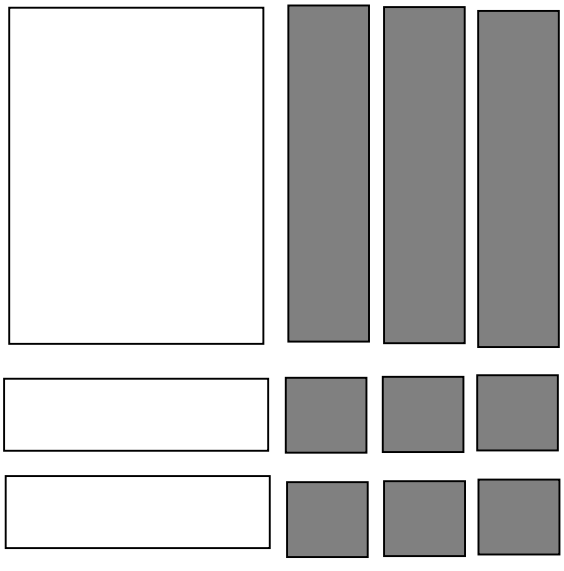


Figure No. 5

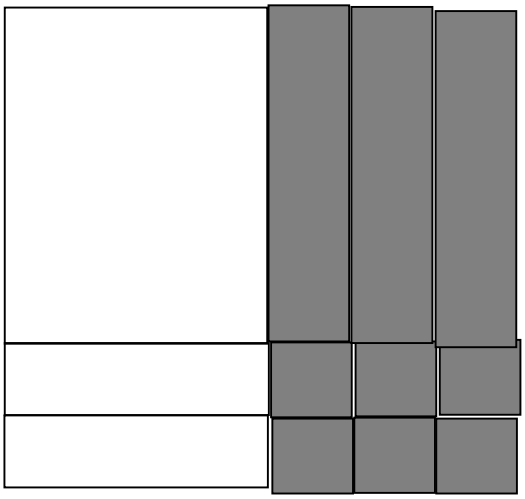


Figure No.6

Area of Figure No. 6 = (x+2) (x-3)

…x^2-x-6 = (x-3)(x+3)

4. Evaluation:

Evaluation is embedded within the activities.

5. Homework:

Do the following:

a. $6x^2$-x-15

b. $8x^2$-6x-9

c. x^2-x-72

d. p^2-3p-4

Lesson Plan No. 6

School: Date:

Subject: Mathematics Time : 45 Mins

Unit : Algebraic expression Class: 8

Topic: Cube of Polynomials.

1. Specific objective

After the completion of this lesson the students will be able to:

a. Derive $(a+b)^2 = a^3+3a^2b+3ab^2+b^3$

2. Teaching materials:

a. To show the extensive form of $(a+b)^3$, showing pieces of a^3, b^3, a^2b, ab^2 the teacher will conduct the following activities using the different teaching methods problem solving, discussion and demonstration respectively.

Activity No. 1:

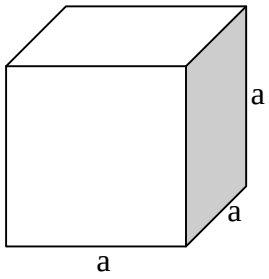


Figure No.1

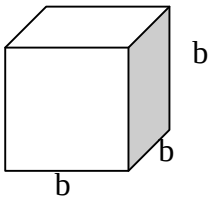


Figure No.2

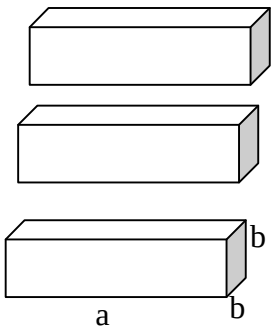


Figure No.3

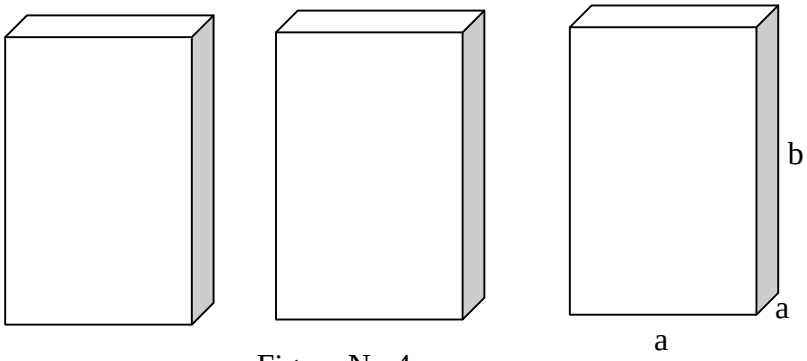


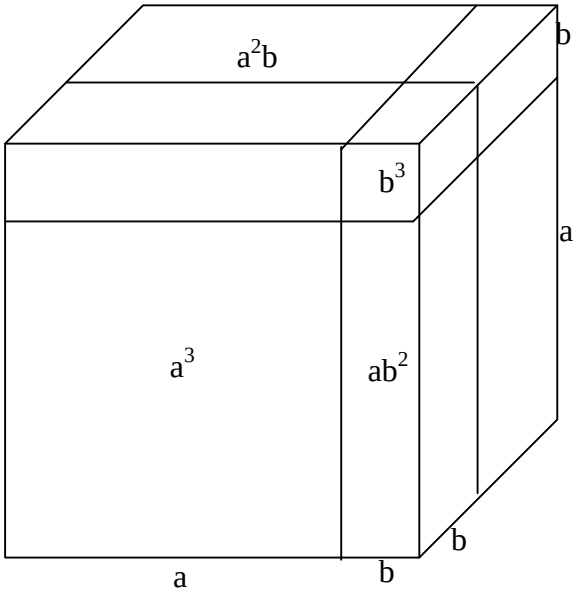
Figure No.4

Here, Volume of Figure no. 1 is a^3 Volume of figure no 2 is b^3

Volume of figure no. 3 is ab^2 Volume of figure no. 4 is a^2b

Activity No. 2

On the basis of above shown pieces of wood, to construct the cube.



We can demonstrate this result using a cube having the length of (a-b) snits as in following

We can see using the actual physical model that

$(a+b)^3 = a^3+a^2b+a^2b+ab^2+ab^2+b^3$

$= a^3+3a^2b+3ab^2+b^3$

3. Evaluation

a. What is the expression of $(a+b)^3$

b. What is the volume of cube.

5. Homework

Do the following

a. $(2x+3y)^3$

b. $(a^2+b)^3$

c. $3x\,\Gamma\frac{1}{3x}^{3}$

d. $\frac{2}{p}\,\Gamma\,p^{3}$

Lesson Plan No. 7

School: Date:

Subject: Mathematics Time : 45 Mins

Unit : Algebraic expression Class: 8

Topic: Cube of Polynomials.

1. Specific objective

After the completion of this lesson the students will be able to:

a. Derive $(a-b)^3 = a^3-3a^2b-3ab^2-b^3$

2. Teaching materials:

Daily used materials and different models having value of a^3,$b^3$$(a-b)^3$.

$(a-b)b^2$ & $(a-b)^2$xb

3. Teaching learning activities:

a. To show the ex4tensive form of $(a-b)^3$. Showing pieces of a3 the teacher conducts the following activities using the different teaching methods. Problem solving, discussion and demonstration respectively.

Activity No. 1:

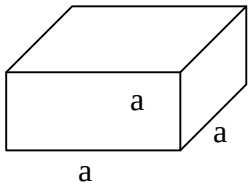


Figure No. 1

Volume of this cube = a^3

Now from the solid a^3 let's take out tin all sides: height, length and breath. It is shown in figure No. 2.

Activity No. 2

Here, this cube is divided into eight pieces, whose volume are $(a+b)^3$, $3 \times b^2(a-b)$, $3 \times (a-b)^2$ & b^3

… $a^3=(a-b) + 3b^2(a-b)+3b(a-b)^2+b^3$

or $a^3 = (a-b)^3+3a^2b-3b^3+3a^2b-6ab^2+3b^3+b^3$.

or, $a^3 = (a-b)^3 + 3a^2b-3ab^2+b^3$

or, $a^3-3a^2b+3ab^2-b^2 = (a-b)^3$.

4. Evaluation

a. What is the extension of $(a-b)^3$.

b. Simplify: $(2y-1)^3$.

5. Homework:

Do the following:

a) $(2x-1)^3$ b) $x Z\frac{1}{x}^{3}$ c. $(a^2b-c^2)^3$

Lesson Plan No. 8

School: Date:

Subject: Mathematics Time : 45 Mins

Unit: Algebraic expression Class: 8

Topic: Cube of Polynomials.

1. Specific objective

After the completion of this lesson the students will be able to:

a. Derive $a^3+b^3 = (a+b)(a^2-ab+b^2)$

2. Teaching materials:

Daily used materials and different models having volume of a^3, b^3, a^2b, ab^2.

3. Teaching learning activities:

During the class period the teacher will do the following activities.

a. To show the extensive form of a^3+b^3, showing pieces of a^3, b^3, a^2b, ab^2, the teacher will conduct the following activities using the different teaching methods: problem solving, discussion and demonstration respectively.

Activity No. 1

Here, a^3, b^3 be two pieces of wood and make a cube in this figure.

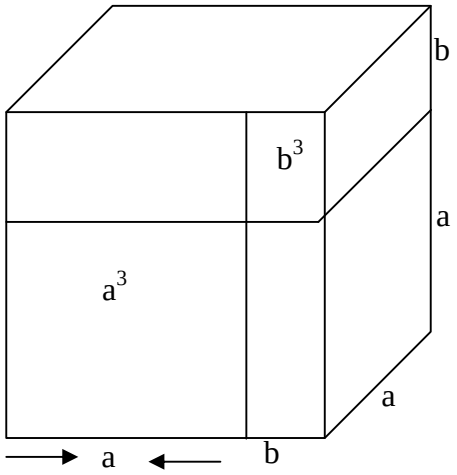


Figure No. 1

Activity No. 2

From above figure there are eight pieces of cube.

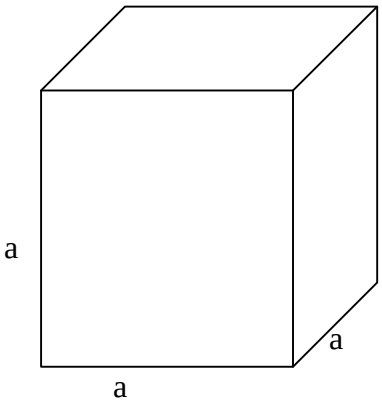


Figure No. 2

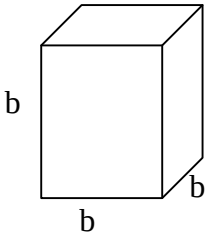


Figure No. 3

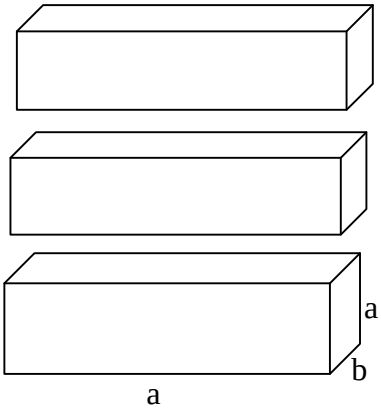


Figure No. 4

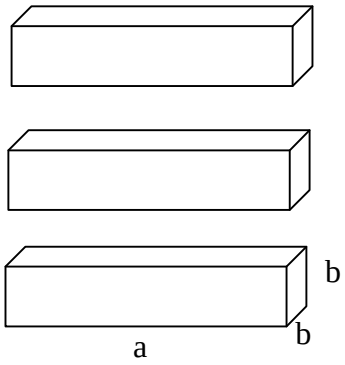


Figure No.53

Volume of Figure No. 1 = Volume of (Fig. No. 2 + Fig. No. 3 + Fig. No. 4+ Fig No. 5)

$(a+b)^3 = a^3+b^3+3a^2b+3ab^2$

$\ldots(a+b)^3=a^3+3a^2b+3ab^2+b^3$

$(a+b)^3=a^3+3ab(a+b)+b^3$

$(a+b)^3-3ab(a+b)=a^3+b^3$

$a^3+b^3 = (a+b)(a^2-ab+b^2)$

5. Evaluation:

What is the extension of a^3+b^3=?

6. Homework

a. x^3+27 b. $a^3+\frac{1}{a^3}$ c. $x^3+(a+b)^3$ d. $8x^3+125$

Lesson Plan No. 9

School: Date:

Subject: Mathematics Time : 45 Mins

Unit : Algebraic expression Class: 8

Topic: Different two cube.

1. Specific objective

After the completion of this lesson the students will be able to:

a. Derive $a^3-b^3 = (a-b)(a^2+ab+b^2)$

2. Teaching materials:

Daily used materials and different models having volume of a^3, b^3, $a^2(a-b)$. $ab(a-b)$, $b^2(a-b)$.

3. Teaching learning activities:

During the class period the teacher will do the following activities.

a. To show the extensive from of a^3-b^3 showing pieces of a^3, b^3, $a^2(a-b)$. $ab(a-b)$, $b^3(a-b)$, the teacher will conduct the following activities using the different teaching methods: problem solving , discussion and demonstration respectively.

Activity No. 1

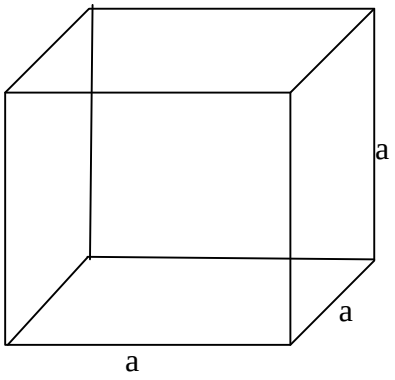


Figure No. 1

Volume of Solid (Figure NO. 1) = a^3

Activity No. 2

Now from the solid a^3, let's cut off b^3. It will be more convenient to take out b^3 from a^3.

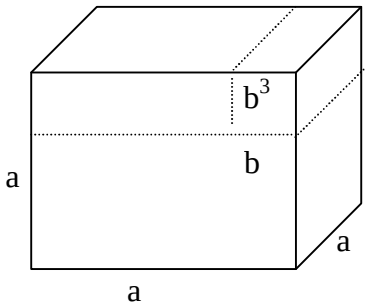


Figure No. 2

Now, we have to calculate the volume of this solid. We can split it into three different cubes.

Activity No. 3

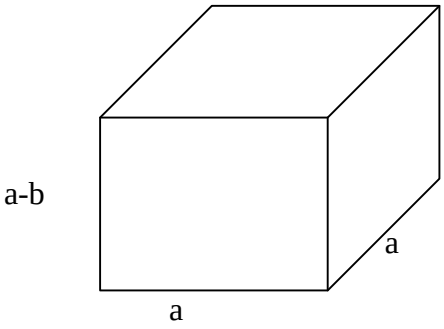


Figure No. 3

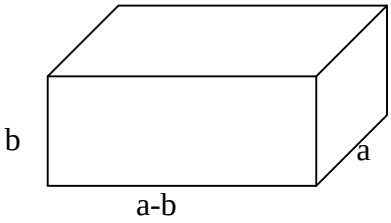


Figure No. 4

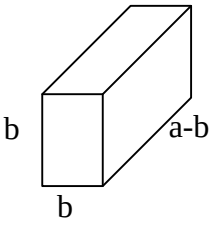


Figure No. 5

The total volume of Figure No 2 = Volume of (fig. No. 3 + fig. No. 4+ fig. 5)

$a^3-b^3=a^2(a-b)+ab(a-b)+b^2(a-b)$

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

4. Evaluation

Evaluation provided the activities.

5. Homework:

a. $(2x)^3-\left(\frac{1}{4}\right)^3$ b. $a^3-\frac{1}{a^3}$ c. a^3-27

Appendix –E

Pretest result of experimental and control group

S.N.	Experimental group	Control group
1	19	18
2	19	19
3	17	9
4	17	7
5	7	8
6	15	7
7	10	7
8	6	9
9	4	8
10	5	3
11	9	3
12	5	9
13	7	6
14	3	6
15	3	6
16	5	4
17	4	8
18	9	8
19	4	3
20	13	5
N=20	Mean = 8.55 Variance = 26.4 Standard deviation – 5.14	Mean = 7.65 Variance = 16.8 Standard deviation = 4.10

Therefore, correlation between E- Group and C – Group $r_{xy} = 0.73$.

Appendix – F

(Post-test result of Experimental and control groups)

In descending order

S.N.	Experimental group	Control group
1	28	25
2	27	23
3	25	20
4	25	15
5	23	13
6	22	11
7	22	10
8	18	10
9	18	10
10	16	9
11	14	9
12	13	8
13	13	8
14	12	8
15	12	7
16	9	7
17	9	6
18	9	5
19	8	5
20	7	5
N=20	Mean = 16.5 Variance = 47.10 Standard deviation =5.14	Mean = 10.75 Variance = 33.56 Standard deviation = 5.79

Value of t-distribution = 2.86, and $t_{0.005,\ 38}$ = 2.57 at ℑ0.01.

Appendix – G

Statistical Formula used in Data Collection and Analysis procedure

S.N.	Subject	Notation	Formula
1	Mean	$(\overline{X})$	$\frac{\phi fx}{N}$ where, x= random variable f= Frequency
2	Variance	(S^2)	$\frac{\phi fd^2}{N} - \left(\frac{\phi fd}{N}\right)^2$
3	Pooled variance	(S_P2)	$\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S_2^2}{n_1 + n_2 - 2}$
4	Standard deviation	(S)	$\sqrt{\frac{\phi fd^2}{N} - \left(\frac{\phi fd}{N}\right)^2}$
5	Parson's correlation coefficient	(R_{xy})	$\frac{N\phi x.y - \phi x \phi y}{\sqrt{N\phi x^2 - (\phi x)^2}\sqrt{N\phi y^2 - (\phi y)^2}}$ Where x and y are paired scores. N = number of paired scores
6	Difficulty level of item	(P%)	$\frac{R_U + R_L}{N} \times 100\ \%$
7	Discrimination index of item	(D)	$\frac{R_U - R_L}{N/2}$ Where, R_u=Number of correct response given by upper 27% students. R_L = Number of correct response given by lower 27% students N = Total students lies on 27%
8	Spearman Brown split half reliability of the test	(r_{tt})	$\frac{2r_{xy}}{1 + r_{xy}}$
9	F-distribution	(f)	$\frac{S_1^2 \text{(large variance)}}{S_2^2 \text{(small variance)}}$

10	t-test of correlated group	(t)	$\frac{\overline{X_1} - \overline{X}_2}{\sqrt{\frac{S_1^2}{N_1} + \frac{S_2^2}{N_2} - 2r \frac{S_1}{\sqrt{n_1}} \frac{S_1}{\sqrt{n_2}}}}$
11	t-statistics	(t)	$\frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\frac{1}{n_1} + \frac{1}{n_2}} \sqrt{\frac{(n_1 - 1)S_1^2 + (n_2 - 1)S^2_2}{n_1 + n_2 - 2}}}$ Where $\bar{x}_1$, and $\bar{x}_2$ are mean of experimental and control groups respectively. S_1^2 and S_2^2 are variance of exp. And control group respectively. n_1 and n_2 are number of student lies on experimental and control groups. r= coefficient correlation between pair of score

Appendix – A_1

Achievement Test (For Pilot test)

विद्याथीको नाम : कक्षा :

विद्यालय रोल नं.

समय: पूर्णाङ्क

विषय: उत्तीर्णाङ्क

Tick ( )the best answer.

1. a^2-b^2 को विस्तारित रुप कुन हो ?

a) (a-b) (a-b) b) (a+b) (a-b) c. (a+b) (b-a) d) (a+b) (a+b)

2. $(a-b)^3$ को विस्तारित रुप कति हुन्छ ?

a. $a^3+a^2b+ab^2+b^3$

b. $(a-b)^3+3ab$

c. $a^3-3a^2b-3ab^2-b^3$

d. $a^3+3ab+3ab^2+b^2$

3. x^6-8 को खण्डीकरण गर्न कुन शुत्रको प्रयोग गर्न सकिन्छ ?

a. (a^2-b^2) b. (a^3-b^3) c. $(a-b)^2$ d. $(a-b)^3$

4. $(x+2)^2$ को मान कति हुन्छ ?

a. x^2+2x+4 b. x^2+4x+4 c. x^2+x+2 d. x^2+2x+2

5. a एकाई भुजा भएको घनको आयतन कति हन्छ?

a. a b. a^2 c. a^3 d. a^4

6. 3cm भुजा भएको घनको आयतन कति हुन्छ ?

a. $9cm^3$ b. $3cm^3$ c. $27cm^3$ d. $18cm^3$

7. $3x^4y^2-x^2y^2+xy$ कति डिग्रिको अभिव्यञ्जक हो ?

a. 2 b. 4 c. 6 d. 8

8. $(a+b)^2$ b (a^2-b^2) को म.स. कति हुन्छ ?

a a+b b. a-b c. $(a+b)^2$ d. a^2-b^2

9. $2x^2-6x$ र x^2-3x को म.स. कति हुन्छ ?

a (x-3) b. x^3-3 c. x^2-3x d. x+3

10. $(a-b)^2$ को मान कति हुन्छ ?

a. $a^2+2ab+b^2$ b. $a^2-2ab+b^2$ c. $a^2+2ab-b^2$ d. $b^2-2ab-a^2$

11. आयतको क्षेत्रफल निकाल्ने शूत्र कुन हो ?

a. l+b b. lLx b c. 2(l+b) d. l^2

12. यदि आयातको लम्बाई ल्र चौडाई b भए आयातको क्षेत्रफल निकाल्ने सुत्र कुन हो ?

a. l+b b. lLx b c. 2(l+b) d. l^2

13. गुणन गर : (5x+3y)(5x-3y)

14 सरल गर $(3x+4y)^3$

15. a^2-b^2 = (a+b) (a-b) चित्रद्वारा देखाऊ

16. गुणन गरः $(ab+b^2)$ (2a+2b)

17. सरल गरः $\frac{m^2 \text{ Z} 4m}{m^2 \text{ Z} 6m}$

18. सरल गर $3x^2+5x(x-2)-8x^2=5$

19. यदि x=5 र y = 7 भए $(x-5)^2$ को मान निकाल ।

20. खण्डीकरढा गर : $x^2-7x+10$

Long Answer Questions

21 चित्रद्वारा $(a+b)^2 = a^2+2ab+b^2$ हुन्छ भनी देखाऊ ।

22. यदि x-y = 2 र xy=15 भए x^3-y^3 को मान निकाल ।

23. x^2+5x+6, x^2-4 र x^2+x-6 को ल.स. निकाल ।

24. यदि $a-\frac{1}{a}$ X5 भए प्रमाणित गर : $a^3-\frac{1}{a^3}=140$

25. यदि $x\Gamma\frac{1}{x}=3$ भए $x^3+\frac{1}{x^3}$ को मान निकाल ।

Appendix – A_2

Achievement test (for Final test)

विद्यार्थीको नाम: कक्षा: ८

विद्यालय: रोल नं.

समय १ घण्टा पूर्णाङ्क : ३०

विषय: गणित उत्तीर्णाङ्क : १०

Object Question

1. a^2-b^2 को विस्तरित रुप कुन हो ?

a. (a-b) (a-b) b. (a+b)(a-b) c. (a+b) (b-a) d. (a+b) (a+b)

2. $(a-b)^3$ को विस्तारित रुप कति हुन्छ ?

a. $a^3+a^2b+ab^2+b^3$

b. $(a-b)^3+3ab$

c. $a^3-3a^2b+3ab^2-b^2$

d. $a^3+3a^3b+3ab^2+b^3$

3. x^6-8 को खण्डकीकरण गर्न कुन शुत्रको प्रयोग गर्न सकिन्छ ?

a. (a^2-b^2) b. (a^3-b^3) c. $(a-b)^2$ d. $(a-b)^3$

4.a एकाइ भुजा भएको घनको आयतन कति हन्छ ?

a. a b. a^2 c. a^3 d. a^4

5. $3x^4y^2-x^2y^2+xy$ कति डिग्रीको अभिव्यञ्जक हो ?

a. 2 b. 4 c .6 d. 8

6. $(a+b)^2$ र (a^2-b^2) को म.स. कति हुन्छ ?

a. (a+b) b. a-b c. $(a+b)^2$ d. a^2-b^2

7. $2x^2-6x$ र x^2-3x को म.स. कति हुन्छ ?

a. x-3 b. x^3-3 c. x^2-3x d. x+3

8. $(a-b)^2$ को मान कति हुन्छ ?

a. $a^2+2ab+b^2$ b. $a^2-2ab+b^2$

c. $a^2+2ab-b^2$ d. $b^2-2ab+a^2$

9. गुणन गर: (5x+3y) (5x-3y)

10. $a^2-b^2=(a+b)(a-b)$ चित्रद्वारा देखाऊ ।

11. गुणन गर, $(ab+b^2)(2a+2b)$

12. सरल गर: $3x^2+5x(x-2)-8x^2+5$

13. $x=5$ र $y=7$ भए $(x-5)^2$ को मान निकाल ।

14. चित्रद्वारा $(a+b)^2=a^2+2ab+b^2$ हुन्छ भनी देखाऊ ।

15. $x-y=2$ र $xy=15$ भए प्रमाणित गर: x^3-y^3 को मान निकाल ।

16. यदि $a-\frac{1}{a}=5$ भए $a^3-\frac{1}{a^3}=140$ हुन्छ भनी प्रमाणित गर ।

Rejected Questions After Item Analysis

1. $(x+2)^2$ को मान कति हुन्छ ?

   a. x^2+2x+4 b. x^2+4x+4 c. x^2+x+2 d. x^2+2x+2

2. 3cm भुजा भएको घनको आयतन कति हुन्छ ?

   a. $9cm^3$ b. $3cm^3$ c. $27cm^3$ d. $18cm^3$

3. आयतको क्षेत्रफल निकाल्ने शुत्र के हो ?

   a. l+b b. lxb c. 2(l+b) d. l^2

4. सरल गर: $(3x+4y)^3$

5. सरल गर: $\frac{m^2 Z4m}{m^2 Z6m}$

6. खण्डीकरण गर: $x^2-7x+10$

7. x^2+5x+6, x^2-4 र x^2+x-6 को ल.स. निकाल ।

8. यदि $(x+\frac{1}{x})=3$ भए $x^3+\frac{1}{x^3}$ को मान निकाल ।

Appendix A_3

Achievement test (for Pre-Test)

विद्यार्थीको नाम: कक्षा: ८

विद्यालय: रोल नं.

समय १ घण्टा पूर्णाङ्क : ३०

विषय: गणित उत्तीर्णाङ्क : १०

1. $5x^2-7x-2x+3$ कति डिग्रिको समिकरण हेा ?

a. 3 b. 2 c. 1 d. 0

2. यदि $x=4$ भए $5x^2+6x-3$ को मान कित हुन्छ ?

a. 101 b. 205 c. 110 d. 200

3. $(a+b)^2$ बरावर कति हुन्छ ?

a. $a^2+2ab+b^2$ b. $a^2-2ab+b^2$ c. $b^2-2ab-a^2$ d. $a^2+2ab-b^2$

4. $(x-2)(x+2)$ को गुणनफल कति हुन्छ ?

a. x^2-4 b. x^2+4 c. x^2-4x+4 d. x^2+4x+4

5. $6x^2-12x\rceil 3x$ को मान कति हुन्छ ?

a. 2x+4 b. 2x+5 c. 2x-4 d. 2x-1

6. a^2xa^3 को मान कति हुन्छ ?

a. a^4 b. a^4 c. a^7 d. a^5

7. 20 र 15 को म.स. कति हुन्छ ?

a. 5 b. 6 c. 7 d. 4

8. 5x+10 को खण्डीकरण कति हुन्छ ?

a. 5(x+2) b. 8(x+5) d. x (3x+5) d. x(2x-5)

9. खण्डीकरण गर: $x^2+7x+10$

10. यदि ab=-18, a+b=-7 भए a र b को मान निकाल ।

11. हल गर: x-y=9

x+y=1

12. ल.स. निकाल: 5xy र $10x^2$

13. गुणन गर : (a+b) (2a-b-3c)

14. सरल गर : $(2x^3x+5)+(2x+4)(2x-4)$

15. यदि एउटा आयातको क्षेत्रफल $(x^3+x^2y+x+3x^2y+3xy^2+3y)$ वर्ग एकाइ, त्यसको लम्बाइ (x^2+xy+1) छ भने त्यसको चौडाई कति होला ?

16. $x\Gamma\frac{1}{x}$ X3 भए $x^3\Gamma\frac{1}{x^3}$ को मान निकाल ।