EFFECT OF MANIPULATIVE MATERIALS IN TEACHING GEOMETRY

A

THESIS

BY

NIR KUMAR BASNET

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

KIRTIPUR, KATHMANDU

2016

31 July, 2016

LETTER OF CERTIFICATE

This is to certify that Mr. Nir Kumar Basnet, a student of academic year 2068-2069 B.S. with thesis number 1117 Exam Roll No. 281714 Campus Roll No 841 and T.U. Regd. No. 9-2-9-899-2007 has completed his thesis under my supervision during the period prescribed by the rules and regulations of T.U. Nepal. The thesis entitled **Effect of Manipulative Materials in Teaching Geometry** has been prepared based on the results of his investigation. I recommend and forward that his thesis be submitted for the evaluation as the partial requirement to award the degree of Master of education.

(Associate Prof. Dr. Eka Ratna Acharya)	(Associate Prof. Laxmi Narayan Yadav)
Supervisor	Head

31 July, 2016

Letter of Approval

Thesis

By

Nir Kumar Basnet

Effect of Manipulative Materials in Teaching Geometry has been approved in partial fulfillment of the requirements for Degree of Master of Education.

Committee for the Viva-Voce	**Signature**
Associate Prof. Laxmi Narayan Yadav (Chairman)	_____
Prof. Dr. Hari Prasad Upadhyay (Member)	_____
Associate Prof. Dr. Eka Ratna Acharya (Member)	_____

ACKNOWLEDGEMENT

I hearty express my gratitude to my respected supervisor, Dr. Eka Ratna Acharya, Departement of Mathematics Education, Tribhuvan, University, Kirtipur Kathmandu for his Valuable suggestions and encouragement during the completion of this study.

Similarly, I would like to express my sincere gratitude to my respected teachers Associate Prof. Laxmi Narayan Yadav the Head of the Department of Mathematics Education, Prof. Dr. Hari Prasad Upadhyay, Mr. Bed Prasad Dhakal, Mr. Abatar Subedi, Department of Mathematics Education, University Campus, Kirtipur for their kind cooperations. I am equally gratitude to all the staffs of Central Department of Mathematics Education of University Campus for their help and support.

My special thanks go to the teacher and students of Janakalyan Higher Secondary School and Himalaya Secondary School of Solukhumbu district. I am very much indebted to my friends of their valuable guidance, encouragement, co-operation and constructive suggestion for the completion of this paper. Similarly, I would like to express my thanks to my family members for their encouragement and support during my study.

Nir Kumar Basnet

Abstract

The study entitled with **Effect of Manipulative Materials in Teaching Geometry** is intended to find out the effect of manipulative materials in teaching geometry of Grade V students. The main objectives of this study were to compare the achievement scores of the students taught by using and without using manipulative materials in teaching geometry and to analyze the effect of manipulative materials in achievement level of students.

To fulfill the objectives of this study, the researcher had adopted experimental, Pre-test Post-test non-equivalent group design. For achievement test two set of questions were prepared for pre-test and post-test. In the same way for three weeks experimental period researcher prepared and validate episode for each period. For the design of this experiment, the researcher purposively selected Himalaya Secondary School and Janakalyan Higher Secondary School from Jubu V.D.C. of solukhumbu district. By the coin toss method, Himalaya Secondary School was selected for experimental and Janakalyan Higher Secondary School for conventional group. There were 19 students in experimental and 22 students were in conventional study school.

The main tools of this study were achievement test and teaching episode for instruments. Mean, standard deviation, variance, t-test were used as a statistical tools to analyze the data. The difference in mean achievement score were tested by using t-test at the 0.05 level of significance. By testing, found that there is significance difference between the achievement scores of students taught by using and without using manipulative materials. It was concluded that the use of manipulative materials was more effective than without manipulative materials in teaching Geometry.

TABLE OF CONTENTS

Lists of Tables and Diagram

Chapter I

INTRODUCTION

Background of the study

Mathematics can be broadly interpreted as something a person does when solving problems in real life situations. It includes the role of intuition, fluidity of mathematical conceptualization, open-endedness, and nature of proof, use of logic and questioning within mathematical contexts (Underhill et al., 1980). We use mathematics in many areas of our lives and we can work on problems within mathematics that use mathematics as a tool, like problems in science and geography. The importance of mathematical skills includes among others, was to enable an individual to cope with their daily life (ibid). Most of the mathematics used in everyday life was embedded in practical problems as Hughes (1986) states that:

> *Mathematics was only "useful" to the extent to which it can be applied to a particular situation, and it was the ability to apply Mathematics to a variety of situations to which we give the name "problem solving". However, the solution of mathematical problem cannot begin until the problem has been translated into the appropriate mathematical terms. This first and essential step presents very great difficulties to many pupils a fact which was often too little appreciated (p.3).*

Also, basic skills of mathematics help an individual to be an independent person who can take care of himself or herself. In line with this, Naggar-Smith (2008) lwasts some important basic skills of mathematics in our daily life. These include: to pay for

purchase and to give change, to weigh and to measure, to estimate and approximate and to understand strait forward timetables. In this sense, if one fails to grasp the simple basics of mathematics, that person may face difficulties in the above realities.

Mathematics was intimately involved in everyday life. Right from the start of human existence on this earth, the use of mathematics has been a part of human activities. It has practical values in human life. We can neither know things correctly nor can we have practical activities of calculation, unless we have knowledge of mathematics. It helps man to give exact interpretation to his ideas and conclusion. Benjamin Pierce one of the American trained mathematics said, "Mathematics was the science that draws necessary conclusion." According to Sidhu (1990), "Mathematics was the numerical calculation related to human life and knowledge. It enables us to solve mathematics problem in our daily life, developmental discipline through cultivating the habit of concentration and self-reliance, prepare for technical service such as accounts, mathematics teaching, auditing, engineering etc, and reasoning so we take mathematics as a way of thinking, means of communication and tools of reflexive thinking. "Mathematics has been taken as the sciences of all science and technology. Thus, mathematics like a language was a basic tool of communication. It was an essential part of the development of science and technology. Thus, mathematics like a language was a basic tool of communication. It was an essential tool for everyday life. It also plays a vital role for the development of science and technology. Math helps people to understand and interpret very important quantitative as well as qualitative aspects of natural phenomena.

Teaching of mathematics includes helping pupils move from concrete to abstract thinking. Pupils need hands-on activities which include direct experience with materials

and visual methods, representing materials and symbolic representation (Westwood 2004). From this perspective, the teachers' role was to make and use different teaching materials. Children must learn to link the new written form of representation with the concrete understanding of number which they already have when they start school (Hughes, 1986). Many studies show that mathematical operations might be performed with the help of visual imagery, which could be compared to some kind of mental board (Reuhkala, 2001). Mathematical ideas can often be represented in any form such as a physical representation, which are external representations, taking the form of language, written symbols, pictures, or physical objects (Ostad, 2001). Mathematical concepts are introduced to the pupils in a practical context through the use of concrete materials (Duncan, 1978).

The Piagetian stage of concrete operation explains that meaningful mathematics are mathematics about which the learner can think more including mental imagery, objects, drawings, and personal experience (Piaget, 1973). Underhill, et al., (1980) argue that the best instructional sequence was one that moves through a sequence of concrete, semi-concrete, and abstract learning experiences. Visual and spatial difficulties may affect a child's ability to use and understand some of the concrete materials used in teaching mathematics (Ostad, 1990; Dowker, 1998). ibid).

Manipulative materials are physical objects such as algebraic tiles, rectangular box, geo-board, fractional pieces, tangram, wooden materials etc they can make abstract ideas and symbols more meaningful and understandable to the students. Working with manipulative materials improves performance on mathematical ideas. In many countries, the use of manipulative devices in all elementary classrooms is recommended. In

elementary students who use manipulative for extended periods of time perform better on achievement test. It is suggest that manipulative materials play vital role towards the student's achievement in mathematics.

Since mathematics is an abstract social science it becomes essential to mathematics teachers to have a special need of instructional materials, which asserts reality to ideas. There are many instructional materials among them manipulative materials is one which play vital role for teaching learning process. Educational materials that are designed to be touches of handled by students and which develops their muscles, perceptual skills, psychomotor skill etc are called manipulative materials. According to Oxford dictionary "Manipulative materials are those materials which skillfully used by hands". Manipulative materials are concrete models that involve mathematics concepts, appealing several senses that can be touches and moved around by the students. Each student needs materials to manipulative independently. Demonstrations by teacher or by one student are not sufficient. With students actively involved in manipulating materials, interests in mathematics can be aroused.

These materials should relate to the students real world. Manipulative materials must be selected that are appropriate for the concept being developed and appropriate for the developmental level of the students. By using manipulative materials children have the opportunity to obtain a higher level of thinking as well as transfer their knowledge into long term memory. It allows students to obtain deeper knowledge of mathematical concepts. They use of these materials develop the skill to build up and manipulate the materials. They also help students to works together co-operatively in solving problems. So these materials make the lead teaching interesting and they can understand easily. For

the improvement of teaching and learning mathematics in school, many attempts have been made to update curriculum and curriculum materials.

The result after teaching with manipulative materials checked by testing the achievement score of the student and achievement was defined in terms of obtained score from taught curriculum examination. Thus the mathematics achievement of children was obtained score from the taught mathematics curriculum examination. According to the dictionary of psychology, "accomplishment or attainment that which has been attained a specific level of proficiency in scholastic or academic work". In the development country achievement was going on broad not only limited with educational achievement, it was considered in the field of psychology, industries, business and medicine.

By another research we can say that the mathematics achievements of student who were taught by using materials were having high score. So mathematics achievement and manipulative materials has strong relation. Manipulative materials are those things which provide the real concept for the unknown things. Every mathematical content are depends upon the materials but all the activity in mathematics we can't present in real world so mathematics was abstract subject. It was more useful for everyday life. For mathematics teaching in elementary level most taught with the use of concrete materials and connection with environment.

Statement of the Problem

For the natural and conceptual learning of mathematics, students must get good involvement at school and teacher provides the conceptual knowledge. In our school mathematics there was no any proper materials and library for mathematics. In such a

way student cannot get real concept of mathematical content. In geometry, materials are more important which provide the real shape of geometrical things and understanding development. But in present situation teacher and student both fill geometry was difficult topic I mathematics.

This study mainly concerned with the mathematics achievement of students of grade V which would be taught by using and without using manipulative materials. So this study would be answered to the following statements.

- Does manipulative material affect the achievement of the students in geometry?
- Dose all students increase the achievement score after teaching with manipulative materials?
- Does students feel enjoyable environment in teaching by using manipulative materials?

Significance of the Study

Mathematics was an essential and widely used subject of school curriculum, so every student should study. Every teacher should teach mathematics with effective way for developing mathematical concept. Such teaching activity helps students to understand the mathematics easily. It has been taught for all pupils as a compulsory subject at school level as well as optional subject. Teaching mathematics was a difficult due to the abstractness of its nature. Students need to construct their own understanding of each mathematical concept, so that the primary role of teaching was not to lecture, explain, to

transfer mathematical knowledge, but to create situations for the students that would foster their making the necessary mental constructions

For developing the mathematical concept manipulative materials are more important in geometry teaching. Materials are those which increase the understanding level and student can learn by self activity with moving and touching things. So this study would be helpful to get information about the effect of manipulative materials in teaching geometry.

- It would be helpful to the teacher and student both for learning mathematics with understanding.
- It would also help to the mathematic subject designer to decide the materials for teaching.
- It would helpful to build of knowledge about using manipulative materials.
- This study would also help to know the effect of manipulative materials in teaching geometry.

Objectives of the study

All research studies have their own objectives. In this sense, this study would intend to accomplish the following objectives:

- To compare the achievement scores of the students taught by using and without using manipulative materials in teaching geometry.
- To analyze the effect of manipulative materials in achievement level of students.

Research Hypothesis

There was significance difference between mean achievement score of student taught by using and without using manipulative materials**.**

Delimitation of the Study

The study would be limited under the following points.

- Study would be limited in mathematics subject topic geometry only.
- Study was limited to grade V students of 2 government schools in Solukhumbu district.
- Purposively selected the V.D.C. of solukhumbu district and selected two different school of this V.D.C.
- This study would excludes the variable like classroom situation student's I.Q. age, parent's occupation which has affect student's mathematics achievement.
- The analysis of the study would be limited in mean, standard deviation and t-test only.

Definitions of Operational Terms

Effect: Impact of the teacher activities and manipulative materials in students learning and their achievement score.

Manipulative materials: The materials which can be manipulate, touch and move.

Government school: School run through the government and government provide the grants for Salary and other purpose.

Achievement: Scored obtained by the student in examination.

Pretest: Test before the experiment.

Posttest: Test after the experiment.

Episode: Preplan strategies for experimental teaching.

Experiment: Period of teaching by using manipulative materials

Variables: Activities that affect the student's achievements.

Independent variables: The variables related to teaching learning activities of the teacher and manipulative materials which effect achievement of the students.

Dependent variable: Achievements scores of the students in the test of geometry in mathematics and feeling of students.

Control group: Group of Students who were taught by without using manipulative materials.

Experimental group: Group of students who were taught by using manipulative materials.

Chapter II

Review of Related Literature and Conceptual Framework

The main purpose of review of related literature was to find out what work have been done and what work has not been done in the area of study being under taken. During the past decade a lot of researcher studied and did research about the teaching different method on mathematics. But no research attempts the effect of concrete way of teaching mathematics. Teaching and learning are two way process. It was an art and complete process and was an interaction between teachers and students. The related literature of this study was given below.

Empirical Literature Review

Amatya (1978) conducted a researcher on "A study of the effectiveness of teaching materials with and without the use of instructional materials" with the aims to find out whether instructional materials are helpful to develop the mathematical concepts and to measure the difference in concept development among students in the experimental and control group of grade V. Sixty students from Lalitpur Nagar Panchayat were selected by using systematic sampling and the experiment was conducted for four weeks duration. The t- test was applied to conclude that the mean difference at 0.05% level of significance. The conclusion was that the performance of the student taught with the use of instructional materials was significantly improved when compared with the performance of the students taught without the use of instructional materials.

Hanna (1986) did a research on sex differences in mathematics achievement of Canadian eight grade students. Five areas were surveyed erythematic, algebra and

probability and statistics geometry and measurement. No significant differences were reported in the performance of boys and girls on the first three subsets. For geometry and measurement, the boy's means was somewhat higher than that of girls. These differences, through not large were statistically significant at the 0.01 level.

Pandey (1995) did an experimental researcher work on "Use of visual aids in teaching fraction". Development of teaching models for teaching fraction in grade VI selecting proper aids and are how effective the prepared model was. A teaching model was visual aids and a plain verbal exposition model was prepared. His researcher showed that the teaching model with visual aids was found to be more effective than the plain verbal exposition model. The tool for the study was interview schedule, classroom observation form. Teaching materials survey form, and researcher's reflective diary notes. The study found that the lecture, question answer and illustration were the major approaches of teaching. This report conducted that trained and experienced teachers had inadequate interaction in the classroom environment. The projects suggest collecting the feedback about the curriculum**.**

Sharma (2001) conducted a research on "A study on the availability and use of instructional materials in teaching mathematics of the primary school of Parbat district in Nepal". In his research he aimed to investigate the availability and use of instructional materials in teaching mathematics at the primary level. For this research 25 teachers teaching primary level mathematics were interviewed. For collecting the data interview was the main tools for the study. For data analysis simple percentage reporting was applied to conclude that the availability of the materials was not found very encouraging. The using materials were meter-scale, compass, clock model and abacus etc.

Ghimire (2005) conducted the research entitled “A study on the effectiveness of teaching algebra by using model at lower secondary level” with the objectives to explore the effectiveness of models in teaching algebra at lower secondary level. The study conducted pre test and posts equivalent group design. The investigator change order develops the test consisting of seventeen multiple choice question and ten subjective items on the basis of the prescribed text book of mathematics of grade eight. The final sample contained sixty student of grade eight. The mean, variance and two tailed t- test were used as statistical tool for the mean achievement of the student taught by using models was significantly greater than the mean score of the achievement of the student of the student taught without using models

Rawat (2011) did the research entitled "Effect of Home Environment of students' Achievement in Mathematics at secondary Level: A case study on Kami students' in Salyan district". In this study, the researcher has used semi-structure, face-to-face interview with two mathematics teachers, five Kami students', their parents and classroom observation. This study was descriptive and qualitative nature. The researcher found that effect of the various home environment factors such as parent's education, parent's occupation , social tradition, family size, poverty and load of household work where the main cause of affecting Kami student's achievement in mathematics at secondary level. The researcher was an added investigation in series of researchers concerning family environment and student's achievement on mathematics. The researcher was concerning family environment and student's achievement on mathematics. The researcher was different than the earlier papers due to three reasons. Firstly, it does not take any one variable, rather it aims at using five different variables

(parents education, parents profession, parent's time to children, tuition at home, entertainment time) affecting family environment. Secondly, this research would be done in the lower secondary level. Thirdly, it has taken into consideration both public and private school in course of the research process.

Shrestha (2011) conducted the research entitled "effectiveness of instructional materials in teaching trigonometry at secondary level." which was amide to find the effectiveness of teaching materials in teaching trigonometry at secondary level. For the study researcher has followed experimental research by selecting two government schools of Sindhupalchok district using purposive sampling procedure. Thirty- six students were selected by random sampling in each of the sample schools. For experimental period researcher applied experimental group with teaching materials and the control group were without materials. After sixteen days, posttest was administrating as the main tools for the collection of data. The pretest and posttest score of the student were tabulated and analyzed by using statistical formulas T-test and F- test. Finally the researcher has found that the use of instructional materials helps teachers while trigonometry at secondary level effectively.

Chaudhary (2011) conducted a research on the topic "Effectiveness of instructional materials on teaching menstruation at secondary level." The researcher was amid to find out the effectiveness of instructional materials on teaching menstruation and to compare the student achievement by teaching with and without materials. The design of the study was pretest posttest equivalent group design. In order to fulfill these objectives the research selected one school randomly in Siraha district. From the school 44 students from grade X were selected for sample of the study. The experimental and

control group was determined by tossing coin. His experiment was run during of 15 days. Before and after test was conducted. For data analysis researcher used t- test which was at 0.05, level of significance. Finally the rescuer concludes that the achievement of student in experimental group was better than the achievement of control group.

Tiwari (2014) conducted a research " impact of manipulative materials in teaching mathematics at basic level" with the aims to compare the achievement in mathematics of the grade V students taught by using manipulative materials and without using manipulative materials and to explore the feeling of students and their activities in the class while teaching them by using manipulative materials. For his study, his research design is pre-test post-test nonequivalent group design. Forty students of two schools were selected at Nawalparasi district. By the researcher himself both groups were taught by himself on the selected unit 'perimeter, area, capacity and volume.' the t-test was applied to conclude the results analysis. He found that the mean achievement score of the students taught by using manipulative materials was higher than the group without manipulative materials teaching. This results shows that manipulative materials are effective in teaching mathematics at basic level.

Thapa (2016) conducted a research on "effectiveness of instructional materials on mathematics achievement of students" with the aims to find out the effectiveness of instructional materials in teaching algebra and to compare the achievement of students in algebra taught by using instructional materials. For this study, his research design is pre-test post-test non-equivalent group design. Forty student of two school of grade VIII selected at Nawalparasi district. He determined experiment group and control group by coin toss method and himself taught both group on the selected unit 'algebraic expression'

at grade VIII. For experiment period researcher applied experimental group with instructional materials and the control group were without materials. After 20 days, post-test was administrated on both groups. The pre-test and post-test score of the students were calculated by using statistical formula t-test at 0.001 level of significance. finally the researcher has achievement score of the students taught by using instructional materials was higher than the group without instructional materials.

Theoretical Review

Vygotsky's Theory of Cognative Development

Vygotsky proposed that adults promote children's cognitive development both by passing along the meanings that their culture assigns to objects and events and by assisting children with challenging tasks (Vygotsky, 1978; Vygotsky Learning theory, 2012). Social activities are often precursors to, and form the baswas for, complex mental processes (Cole, 1996; Vygotsky Learning theory, 2012). Children initially use new skills in the course of interacting with adults or peers and slowly internalize these skills for their own, independent use (Vygotsky, 1978; Cole, 1996; Vygotsky Learning theory, 2012) .Van Oers (1996); Reys et al., (1998); Skemp, (1989) supports the Vygotskian approach to teaching and learning process by stressing the importance of social interaction and discussion in learning. In line with this, Pound (1999) argued that social interactions help children to make connections between the separate bits of information they acquire through their own actions, observations and reflection. Often, children first experiment with adult tasks and ways of thinking within the context of their early play activities (Vygotsky, 1978; Cole, 1996).

His theory involved a child internalizing the sign systems of the culture in order to think and solve a problem without the assistance of others (ibid); (The cognitive theories of Piaget and Vygotsky, 2009). The first step in development was the acquisition of language and understanding that actions and sounds have meaning. Culture was transmitted through language; therefore, language and communication are important sign systems (Bruner, 1990; The cognitive theories of Piaget and Vygotsky, 2009). Another trait of language was private speech. Private or internal speech was significant in guiding actions and promoting learning in children and adults (Vygotsky, 1978); (ibid). The next stage of Vygotsky's cognitive development theory involves the zone of proximal development, which was the next level of development immediately above a person's present level (ibid). In other words a person was in the zone of proximal development when they can accomplish a task with the assistance of another that they could not do alone. The final stage in his cognitive theory involves scaffolding, which allows for assistance to facilitate mastering a new concept. Scaffolding occurs within the zone of proximal development and helps the student become autonomous in their learning. Vygotsky (1978) considered that the child's cognitive development was determined by two developmental levels: actual developmental level and the zone of proximal development.

Actual developmental level represents an already completed developmental cycle which contains what the child was able to do alone. In other words we can say that it was the independent level of mastery or what s/he has already mastered and achieved alone. Vygotsky introduced the notion of Zonal of Proximal Development (ZPD) in the process

of child learning and development of higher mental psychological function (ibid). Vygotsky (1978) argues that:

> *Every function in the child's cultural development appears twice. One was on the social level and later on the individual level. First between people (inter psychological) and then inside the child (intra psychological). This implies equal to voluntary attention, to logical memory and to the formation of concepts. All the higher functions originate as actual relationship between individuals (p.57).*

Vygotsky emphasizes the relationship between humans and the social cultural context in which they act and interact in shared experiences (Crawford, 1996; The cognitive theories of Piaget and Vygotsky, 2009). According to Vygotsky (1978) the Zone of Proximal Development (ZDP) represents the distance or gap between the actual and potential level, between what an individual child was able to do alone and what s/he can achieve 'through problem solving under adult guidance or in collaboration with more experienced or capable peers or adult (Vygotsky, 1978; Rogoff, 2003). Therefore, learning development was the result of interaction between the child and his/her environment (Vygotsky, 1978; Vygotskian perspective on cognitive development, 2002). Learning activities that follow within a child's zone of proximal development have a high probability of success, whereas activities beyond the zone may result in a failure and frustration (Reys et al., 1998).

The environment in school perspective represents teachers and peers in class and in play. As it may be seen from Vygotsky's theory, a prerequisite to teach pupils mathematics was first to determine their actual levels. According to Vygotsky's theory of

cognitive development, learning was a result of interaction between pupils and more capable peers (Vygotsky,1978). With some guidance directly or indirectly from an adult or peer, a child can master the knowledge, skills or strategy very easy (Westwood, 2004).

In connection with Vygotsky idea of Zonal of Proximal Development, guided participation was another idea established by Rogoff (2003). She also stated that through cooperation, pupils became their own teachers in the process of guided participation and shared understanding of activities. Also, Rogoff, (2003) argues that:

> "*guided participation provides perspective to help of focus on the varied ways that children learn as they participate in and are guided by the values and practice of cultural communities*"(p.283-284).

In addition to guided participation, apprenticeship was another idea provided by Rogoff (ibid). Apprenticeship was the process of learning by involvement through observation (ibid). In supporting Vygotsky idea, Bruner (1990) provides the notion of scaffolding as explained in section 2.5.6 linked to the Zone of Proximal Development. There are two ways in which caregivers scaffold or assist young children in learning a language (ibid). First, was by joint instruction of language and second was by gradually withdrawing their support as children gain independent mastery of language. From this perspective of scaffolding, a pupil with low mathematical skills, when given a complex task by the teacher and try to solve it and fail, a teacher must use any effort to assist or help this pupil so as to understand the task and accomplish it. In scaffolding the teacher or aide models the expected behavior and then guides the student through the early stage of understanding.

The student understands increases as the teacher gradually withdraws. Furthermore, Social constructivism was a philosophy which emphasizes culture and context in understanding what occurs in society and constructing knowledge based on this understanding (McMahon, 1997; Social Constructivism- Emerging Perspectives on Learning, 2008).

Also, Vygotsky emphasizes that the classroom interaction between students and teachers and creative collaboration help pupils to accomplish their work (Wells & Claxton, 2002). His work emphasizes three main themes. The first was the importance of culture, the second was the central role of language, and the third was what he termed the "zone of proximal growth or development (ZPD)" (Vygotsky, 1978; The Teaching and Learning of Competence Based Mathematics, 2010). The Zone of Proximal Development emphasizes the construction of knowledge within a cooperative environment.

Theory of Transmission

Vygotsky defined those who are to teach as the "More Knowledgeable Other." The MKO was anyone who has a better understanding or a higher ability level than the learner, particularly in regards to a specific task, concept or process. Traditionally the MKO was thought of as a teacher or an older adult. However, this was not always the case. Other possibilities for the MKO could be a peer, sibling, a younger person, or even a computer. The key to MKO was that they must have more knowledge about the topic being learned than the learner does. Teachers or more capable peers can raise the student's competence through the zone of proximal development (ZPD).

Vygotsky's findings suggest methodological procedures for the classroom. "In Vygotskian perspective, the ideal role of the teacher was that of providing scaffolding

(collaborative dialogue) to assist students on tasks within their zones of proximal development." During scaffolding the first step was to build interest and engage the learner. Once the learner was actively participating, the given task should be simplified by breaking it into smaller subtasks. During this task, the teacher needs to keep the learner focused, while concentrating on the most important ideas of the assignment. One of the most integral steps in scaffolding consists of keeping the learner from becoming frustrated. The final task associated with scaffolding involves the teacher modeling possible ways of completing tasks, which the learner can then imitate and eventually internalize.

Vygotsky recommended a social context wherein a more competent learner would be paired with a less competent one, so that the former can elevate the latter's competence. This social context promotes sustained achievement and cognitive growth for less competent students."Accordingly, students need to work together to construct their learning, teach each other so to speak, in a socio-cultural environment. In-class opportunities for collaboration on difficult problem-solving tasks would offer support to students who are struggling with the material. By interacting with more capable students who continue to mediate transactions between the struggling students and the content, all students would benefit.

The implications of Vygotsky's theories and observations for educators are several and significant. In Vygotsky's view, the teacher has the collaborative "task of guiding and directing the child's activity. Children can then solve novel problems "on the basis of a model he has been shown in class." In other words, children learn by solving problems with the help of the teacher, who models processes for them and his or her

peers, in a classroom environment that was directed by the teacher. In essence, "the child imitates the teacher through a process of re-creating previous classroom collaboration. It was important to note that the teacher does not control the class with rule and structure; rather, the teacher collaborates with the students and provides support and direction.

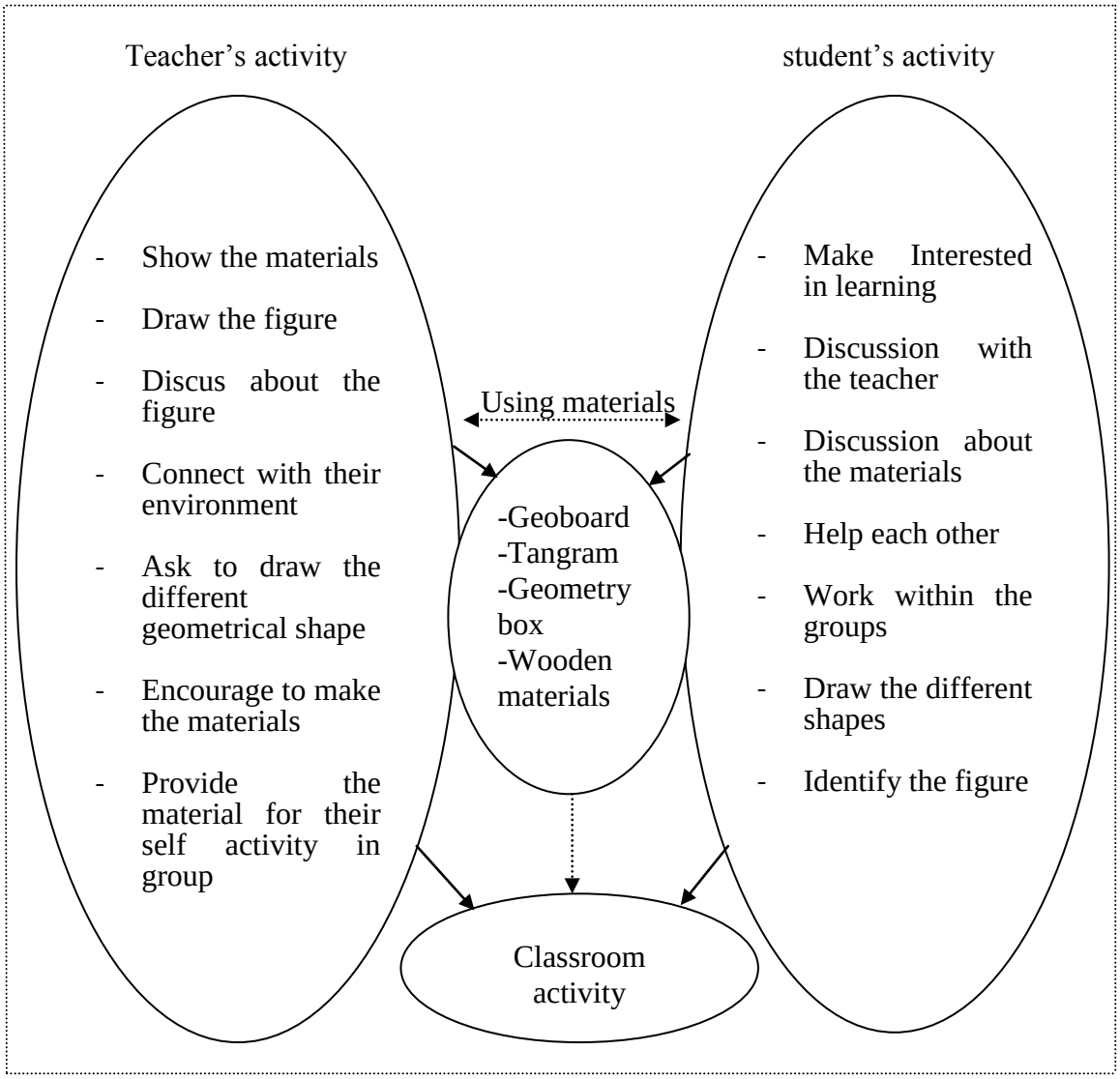
In our research, we found limited references to Vygotsky's specific views on curriculum content. One exception involves the teaching of writing to preschoolers. According to Garton and Pratt, Vygotsky argued for shifting the teaching of writing to preschool. They explain that Vygotsky differentiated between two forms of speech: spoken and written. Vygotsky, as cited by Garton and Pratt, asserts that a child develops an understanding that spoken speech can be symbolized in writing by progressing from "drawing things to drawing speech."Vygotsky suggested then that the preschool curriculum should be designed so that it was organized to "ease child's transition from drawing things to drawing speech."

In sum, Vygotsky's findings suggest that the curriculum should generally challenge and stretch learner's competence. The curriculum should provide many opportunities to apply previous skills, knowledge and experiences, with "authentic activities connected to real-life environment since children learn much through interaction, curricula should be designed to emphasize interaction between learners and learning tasks.

Conceptual framework

Conceptual framework was the researcher plan for finalized the thesis. This frame work depends up on the fulfillment of the objectives of the research. By conceptual frame work methodology and analysis of the data would be derived. In this research researcher would follow the following process for finalized the thesis.

Diagram: I (Classroom Activities using Manipulative Materials)



Source: Lida J. (2009). Teacher variable and student's mathematics learning related to manipulative use.

Framework connects the research objectives, hypothesis of the study, theory and the methodology of the study. In this frame the teachers and students activity for the experimental period would be provide. This frame also connects the students and teachers activity with the teaching materials. For the period of experiment researcher prepaid the episode for teaching topic. Then researcher teaches in the classroom of experiment group by using the materials and make satisfaction in teaching learning activity by impressing the students. Researcher asked different question about the topic and make discussion under the question, first researcher encourage the students to solve the problem themselves then teacher would provide the idea to solve the problem. For the students activity the manipulative materials encourage students to actively participate the classroom activity.

After this process researcher also used the related manipulative materials for providing the clear concept of the topic. By the above process the data were collected and the tabulate the data then after found the result by analyzed the statistical tools. Then calculate the result of the research and analyzed the result by the score of analysis tools.

Chapter- III

METHODS AND PROCEDURES

Chapter three would be presents the methodology used to seek solutions to the problem and questions under study. This part explains the research design, process of data collection, consists of a sampling procedure, methods and instruments, collecting procedure of data and analysis procedure.

Design of the Study

This was an experimental pre-test and post-test non-equivalent model study which is based on quantitative approach. This was an experimental research with builds on descriptive data that has been collected in the field. The study was specially focused in the student achievement by teaching with manipulative materials. The design of the study was depends under the groups with manipulative materials and without materials which as follows;

Table: 1 Pre-test Post-test Design

Group	Pre –Test	Treatment	Post-Test
E_R	E_1	Teaching with materials	E_2
C_R	C_1	Teaching without materials	C_2

E_R - Experimental Group

C_R - Control group

E_1 - Pre test of Experimental Group

E_2- Post test experimental group

C_1- pre test control group

C_2- Post control group

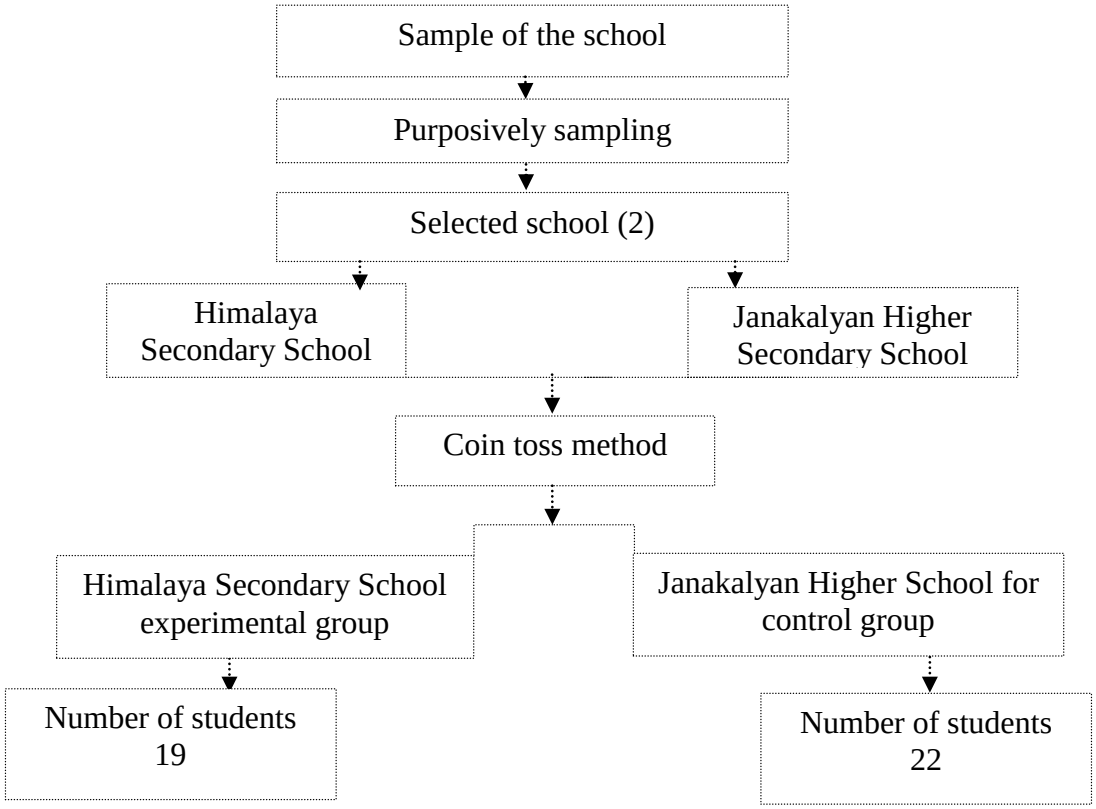
Population of the Study

The population of the study included the grade V students of 266 schools in Solukhumbu. For this research area, the researcher also hade sound access to reach in this area to perform different task and fulfils the objectives of the study. Due to the time and cost limit it was also an essential to select this study area.

Sample of the Study

For this research, researcher would purposively select a Jubu V.D.C. of solukhumbu district and selected two different schools of this V.D.C. To determine the experimental and control group researcher used coin toss method. By coin toss Himalaya Secondary School was selected for experimental group and Janakalyan Higher Secondary School was selected for control group. Among them experimental group was taught by using manipulative materials and control group was taught by without materials.

Diagram: II Sampling Procedure



Instrument/Tools of the Study

The main instrument for this study would be achievement test paper. So, the researcher developed an achievement test paper from the mathematics textbook of grade V, prescribed by the government of Nepal. It included the geometrical figure such as triangle, square, rectangle, quadrilateral etc. The achievement test paper contained objective question with multiple choice. For the experimental period teacher made episode and taught by using manipulative materials. For experimental period teacher used manipulative materials like as tangram, geo-board, geometry box, wooden materials etc.

Variables

The main aims of this study to find the effect of independent variable 'manipulative materials' over the dependent variable 'achievement'. So In this study, independent variables were those, which were directly related to teacher activities and knowledge with using manipulative materials like tangram, geoboard, geometry box and other wooden materials. In this research student's achievements was directly affected by the teachers activity with manipulative materials so the achievement of students was dependent variable which depends upon manipulative materials

Internal and External Validity Threats and control Exercised in the Experiment

Intervening variables such as parental education and socio- economic condition, teacher’s qualification, condition of both schools were almost the same in the both groups. Those students who were more extra due to his parent guide and education were not included in this research. Those students of whose socio-economic condition were high also excluded on this research. In the case of socio-economic condition, all students

were likely from farmer and poor economic condition. Hence in both group the students were from farmer having the same economic condition.

The possible threats in the control variable of the study were maturation, location, instrument and researcher characteristics. Location and historical threats were controlled by selecting the school from same area, location and geographical condition. The researcher characteristics and bias was not the threat for this study because the researcher followed the same knowledge and behavior, emotion and strategies in both group. Certain extraneous variables cannot be controlled directly like as subject matter taught, evaluation applied and equating the group. But for this purpose, same content was taught to both the experimental and control groups from the same curriculum, same text book prescribed by government of Nepal. In the initial the same pre-test was given to the both group and also use the same post test paper for both groups.

Pre Experimental Stages

In this stage manipulative materials would collected and episodes were prepared. For preparing teaching episodes, researcher followed the teacher guide and took help from the subject teacher. Also prepared the pre-test achievement test paper and it is reformed by piloting among 15 students. After piloting the test paper was administrated to both experimental and control group.

Experimental Stages

In this stage the researcher would teach the experimental group with materials and control group without materials**.** The classroom activity would be run for three weeks as the presented activity in conceptual frame work.

Post Experimental Stages

In this stage, first the researcher prepared post test achievement test paper which was parallel to the pretest achievement test paper. After that researcher would be collect the data for analysis and interpretation by using statistical tools and technique.

Reliability and Validity of the Instrument

For the reliability of the test researcher select the questionnaire form the previous question in the same content and same topic. Which was previously made reliable and refine the question by piloting and calculating the difficulty index (P-value) and discrimination index (D-value) of each item in the instrument? The P-value and D-value of each item would calculate from the 27% of the highest scores and 27% of the lowest scores of 15 students participated in the pilot study. For the reliability coefficient here was also calculated the split half reliability.

For the validity of the question the researcher started to made question by using specification chart of the grade five mathematics, Curriculum, textbook, and teacher's guide. Then after preparing the question, researcher share with subject expert, subject teacher and also with the research supervisor. By the help and discussion of the related person researcher reform the question and prepare for the final test.

Data Collection Procedure

Prior to the administration of the achievement test, the researcher would visit selected school. The researcher would meet the headmasters and would explain in details the purpose of the visit. Before administrating the test paper, the researcher would explain the data collection procedure of mathematics achievement test to the students.

After the time duration of examination the answer sheets would collect and would score by the researcher and the score would tabulate for the analysis which only for pre test. The questionnaire design was followed for both pre test and post test as,

Table – 2

Scoring Strategies

Group	Types of question	Number of question	Marks
A	Very short question	10	10×1 = 10
B	Short question	10	10×2=20
C	Long question	5	5×4=20

For experimental stage researcher would select two different schools and would be taught one for using materials and another for without using materials in geometry teaching. In this period researcher would be made episode for teaching.

After finish the experimental stage the researcher conducted the pos test as same as the pre test design. Then collect the data and prepare for the data analysis steps.

Data Analysis Procedure

The collected data would be analyzed by using different statistical techniques which are given below. The mean and SD would be used. The t-test at 0.05 levels of significances would used to compare the mathematics achievement of students taught by using and without using manipulative materials.

The statistical tool t-test or z-test was used for find out the significant difference between mean scores of experimental and control group. The level of the significance of the research hypothesis would be at 0.05. Descriptive analysis would be adopted to find the effect of manipulative materials in teaching geometry.

Statistical Technique Used

The statistical tool t-test was used to find out the significant difference between mean scores of experimental and control group. The rule of finding the t-test was as follows;

$$t = \frac{\overline{x_1} - \overline{x_2}}{\sqrt{\frac{(N1-1)S_1^2 + (N2-1)S_2^2}{N1+N2-2}\left(\frac{1}{N1}+\frac{1}{N2}\right)}}$$

Where,

$\overline{x_1}$= mean of the 1st sample, $\overline{x_2}$ = mean of the 2nd sample.

S_1^2=variance of 1st sample , S_2^2 = variance of 2nd sample,

N_1= number of the sample in the 1st sample,

N_2= number of the sample in the 2nd sample.

Chapter IV

ANALYSIS AND INTERPRETATION OF DATA

Chapter four presents the result of the thesis from the field data. The researcher collects the data and presents the data in table. Then calculate the pre- test and post- test score from the data. By the help of the score, the researcher calculates the mean, SD, variance and t-value from the tabulated score.

In this research, researcher study about the student's achievement in geometry by teaching using manipulative materials and without using manipulative materials. For this research researcher takes two schools by random sampling and one school selected for experimental and another one was selected for traditional by quoin-toss method. The total students in experimental school, Himalaya Secondary School was 19 and control school, Shree Janakalyan Higher Secondary school was 22. First researcher takes pre- test and after experiment researcher also takes post- test. Then the pre- test and post test score of the students was analyzed by statically calculation as follows;

Pre-test Comparison between Achievement of Experimental and Control Group

There were 19 students in the experimental groups and 22 students in control groups. The pre-test score of the students of both experimental and control group were presented in APPENDIX -B and the summarized calculation of both groups on the pre-test was presented in the table.

Table - 3

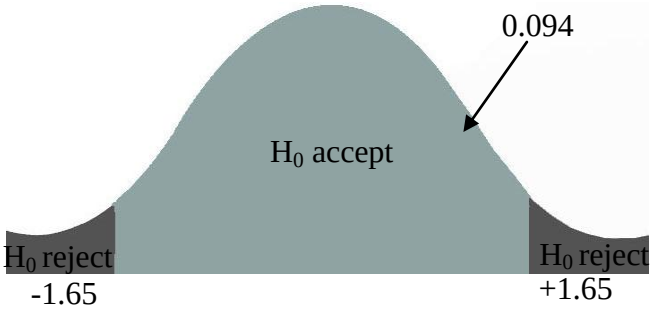
Group	No. of Students	Mean	Variance	Standard Deviation	t-value	Level of significance
E	19	21.26	32.93	5.74	0.094	One tailed 0.05
C	22	20.68	41.85	6.47		

Tabulated value $t_{0.05}$, 39 = 1.65

Discussion based on table

The above Table-3 presented the mean, standard deviation and variance of both the groups, experimental and control group. In the table, bother the mean score of experiment group have not any remarkable difference. In other words, the mean scores of experimental group were 21.26 and the mean score of the control group was 20.68. The standard deviation of experimental group was 5.74 and control group was 6.47 in orders to see their initial difference existed between the two groups t-test was employed. The calculated t-value was 0.094 and the tabulated t-value 1.65 at 5% level of significance. In other ways, the null hypothesis was not rejected. By this we conclude that the means of two groups were not found to be significance difference. The t-value was rejected or accepted we decided as the following curve.

Representation in normal curve



This figure shows that how we decide t- value was rejected or accepted. For this calculation tabulated value was 1.65 with 0.05 level of significance and degree of freedom 39. Calculated t- value was 0.094. The calculated value was lies between +1.65 to -1.65. So this region accepts the null hypothesis. Then we can say that there was no significance difference between control group and experimental group.

Post-test Comparison between Achievement of Experimental and Control Group

There were 19 students in the experimental groups and 22 students in control groups. The pretest score of the students of both experimental and control group were presented in APPENDIX -D and the summarized calculation of both groups on the post-test was presented in the table.

Table - 4

Group	No. of Student	Mean	Variance	Standard Deviation	t- value	Level of significance
E	19	29.47	56.46	7.51	2.89	two tailed 0.025
C	22	23.18	41.88	6.47		

Tabulated value $t_{0.025}39 = 1.96$

Discussion based on table

The above Table-4 presented the mean, standard deviation and variance of both the groups, experimental and control group. In the table, bathe the mean score of experiment and control group was different. In other words, the mean scores of experimental group were 29.47and the mean score of the control group was 23.18. The

standard deviation of control group was 7.51 and experimental group was 6.47 in orders to see weathered initial difference existed between the two groups t-test was employed. The t- value and hypothesis was decided by the following figure.

Representation in normal curve

The calculated t-value was 2.89 and the tabulated t-value were 1.96 at 5% level of significance. In other ways, the null hypothesis was not accepted. This shows that the calculated t- value was grater then the tabulated value. There for the null hypothesis was rejected and alternative hypothesis was accepted. This implies that there was significance difference between mean achievement score of experimental and control group. We also say that there was significance difference between teaching with manipulative materials and without materials. Therefore the researcher concludes that the student of experimental group was significantly benefited in the achievement score then the student of control group. It means that the teaching with manipulative materials provide the better result in teaching geometry.

The Quantitative Analysis for the Effect of Manipulative Materials in Teaching Geometry

After collecting the statistical data researcher analyzed effect of the teaching strategies. By the pre-test mean score of experimental and control group was 21.26,

20.68 which shows that the mean score of both groups was no significance difference. By the hypothesis checking the null hypothesis of no significance difference group was accepted. The SD of the experimental and control group were 5.74 and 6.47 which shows that the distribution from the mean score of the students. This score shows that distribution from mean is no higher in both group and students were average in study. By the t-test of pre test score the calculated t-value was 0.094 but the tabulated mean t- value was 1.65 which shows that the null hypothesis was accepted. It means that the experimental and control group has no significance difference.

In the experimental period researcher teach the classroom by using manipulative materials in experimental group and without materials in control group. The experimental period was run for two weeks only. After experimental period the data were collected then calculated mean, standard deviation and variation. By the result the mean score of the students in experimental and control group were respectively 29.47, 23.18 which shows that there was significance difference between the mean score of both experimental and control group. It means that the experimental group had higher mean score then the group of control by teaching conventional method. The SD and variance of experimental and control group were respectively 7.51, 56.46 and 6.47, 41.88. This shows that the highest score and lowest score of the students in experimental group was more distributed from mean score than the score of the students in control group. The t-test of statistics, the calculated t- value was 2.89 and tabulated t-value with the level of significance 0.05 was 1.96.by testing of hypothesis the null hypothesis was rejected it means that the research hypothesis was accepted. By the research hypothesis we can say

that the experimental group with teaching by manipulative materials was more effective then the control group without materials.

The analysis of the group score shows that the group of students in experimental group had better achievement than the control group. By the result the mean score of experimental group was higher than the mean score of experimental group. Due to the cause of manipulative materials the achievement score of the students was distributed. So this part we analyzed by short description about manipulative materials and important facts and why this manipulative material be useful effectively in teaching.

Manipulative materials are objects designed to represent explicitly and concretely mathematical ideas that are abstract. They have both visual and tactile appeal and can be manipulated by learners through hands-on experiences. Manipulative benefit the learning and teaching of mathematics. Teacher use of manipulative needs to be strengthened through appropriate professional development within the overall context of the student's learning of mathematics. There was strong teacher support for manipulative use in the earlier grades of primary school. However, all children need access to and availability of a wide range of manipulative as they meet new mathematical concepts and continue to construct.

In order to help students to construct geometric ideas, concrete educational materials such as geometry rods, geo board, isometric papers, symmetry mirrors etc. are to utilized. This utilization also provides an opportunity for the teacher to assess and meet the needs of primary school students as they construct personal mathematical knowledge. The ultimate goal of using manipulative in math instruction was to help children handle abstract concepts and the symbols that are used to represent these concepts. The most

important responsibility belongs to the teacher at the point of using of the teaching materials at the teaching process. The teachers who are the practitioners of the curriculum and facilitators of learning environment should be consciously aware of the critical impact of learning materials on providing the students with problem solving skills. On the other hand, using concrete materials to teach mathematics was currently a well-established pedagogical strategy throughout the world.

By using manipulative materials students were show active and they feel enjoy when they were involved in learning with moving, touching and joining wooden materials. So teaching learning activity was affected and increases their understanding mathematical concepts. This can be showed by the following question of the researcher and response of the students view;

Question: *Can you say yours feeling about such types of teaching learning activities with manipulative materials?*

Respondents answered:

> *Our mathematics teacher teaches us by traditional method. He does not use any kind of materials when teaching geometry but you used the manipulative materials in teaching geometry. Our teacher only write the definition and sketch the geometrical figure and said to us copy. But you said different type of question about the topic and make discussion between our students group, also provided the different materials which increase our understanding mathematical concept. So we can learn easily and also understand*

basic concept about the topic. Now we are so happy because we get chance to learn mathematics so enjoyable way.

By the above response of the students shows that they were more actively participated in teaching learning activity also according to the attendance board students number of presents in the classroom was increased and regularity. The students of experiment group seem to be more satisfied and enjoyable with classroom activities because of using manipulative materials. They expressed their common attitude that they were able to solve such types of geometrical problems with using manipulative materials. The views of the student in indicate that the teaching geometry without using manipulative materials is not meaningful teaching. Without using materials in teaching geometry the teaching is incomplete and bored for the students also. The use of manipulative materials in teaching and learning in which the teacher and learner are highly participate and actively involved in that process.

Manipulative by themselves have no inherent meaning. It was important for teachers to make this meaning explicit and help students build connections between the concrete materials and the abstract symbols that they represent. This holds true for both concrete and virtual manipulative but virtual manipulative often have this type of structure built in. Many virtual manipulative activities give students hints and feedback, something that the more traditional concrete manipulative cannot do without teacher assistance. For example, using Tan grams students can virtually copy a design made from pattern blocks, and when a block was near a correct location, it would snap into place. This virtual manipulative also includes a hint function that would show the correct location of all the blocks. Additionally, virtual manipulative often provide explicit

connections between visual and symbolic representations, a feature which was found to benefit learning.

Manipulative are easy to use and as engaging as concrete ones. Although concrete manipulative provide some support for individual student use, as with physical manipulative students benefit from teacher guidance to help them use the manipulative correctly and connect to the related mathematics. Most manipulative include activities and suggestions for teachers as well as ideas for student discussions and sharing. They can also be used with interactive whiteboards, so that the teacher can involve the whole class in an interactive lesson and her colleagues have developed an additional resource, an Instructional Planning. For the most part, classroom use of manipulative has involved concrete, or physical, manipulative. Manipulative are with structured activities or suggestions to aid implementation in the classroom.

Abstract concepts are essential to understanding and performing mathematics. They are also a source of difficulty for many students who struggle with mathematics, many of whom find even basic mathematics concepts difficult to understand. A popular approach to help students understand abstract concepts was the use of manipulative. Manipulative enable students and teachers to represent concretely the abstract concepts that they are learning in mathematics class and to link these concepts to prior knowledge. Although they are used primarily in the elementary grades, they offer a useful means to introduce new concepts to all students. By the above discussion manipulative materials in teaching geometry was most essential material in teaching geometry at primary level.

Chapter V

SUMMARY, FINDINGS, CONCLUSION AND RECOMMENDATIONS

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

Summary

This research study was concerned with the study of the effectiveness of manipulative materials in teaching geometry at primary level. For this study, the researchers develop test items with the help of the prescribed curriculum and text book of grade 5 mathematics. Achievement test paper and the teaching episode were the main instruments for the study.

For field study, the researcher selected the two school of Solukhumbu district random. The selected schools were Himalayan Secondary School and Janakalyan Higher Secondary School. For determine the experiment and control group researcher used coin tossing method. By coin toss Himalayan Secondary School for experiment group and Janakalyan Higher Secondary School for control group was categorized. In experimental group there were 19 students and in control group there were 22 students. At first pre test was administrated on both groups. Then the experimental group was taught with using materials and control group was taught without using materials. The scores of the students were analyzed by using the mean, variance, SD, and t- test

By the analysis of score the experimental group was found to achieve better than the control group. That means the achievement of the students teaching with manipulative materials was higher than the achievement of the students teaching without manipulative materials in geometry at grade V. finally we can say that the manipulative materials in teaching geometry was more effective materials which can help to the students to develop their understanding power.

Findings

By the analysis of the result the most important findings as follows,

- The mean achievement score of experimental group was 29.47 and the mean achievements score of control group was 23.18. This shows that, there was significant difference in mean achievement score of students taught by using manipulative materials and without materials.
- By the post test result the student in experimental group were hade high mean score then the student's in control group.
- The pre test and post test comparison the class room teaching by manipulative materials was more effective then the without materials.
- By the response of the students, researcher found that the teaching learning activity by using manipulative materials inspire the students and they were feel enjoyable environment also actively participated in teaching learning activity.
- After the statistical analysis researcher can say that the effect of manipulative materials in mathematics achievement was positively increased.

- The manipulative materials in teaching geometry are more important materials for providing the real concept of mathematics activities.
- Finally researcher can say that manipulative materials enhance the student's power of understanding.

Conclusion

On the basis of above findings the conclusion were drawn as a result of geometry instruction using manipulative, the group increased their skills and showed more interest and enjoyment when learning was done through the use of manipulative. The students were visibly more active in class and develop more self confidence in their math skills. However, manipulative do not always magically assist student's learning mathematical concepts. Some student scores decreased when taught using manipulative rather than increased. Overall, they provide a concrete way for students to link new, often abstract information to already solidified and personally meaningful networks of knowledge, thereby allowing students to take in the new information and give it meaning. It seemed that the students in this experimental group enjoyed working with manipulative materials to measure sides, angles and classification of the triangles on the basis of sides and angles although, the Alternative hypotheses could not be rejected at 0.05 significant level. This research proves that the use of manipulative and without manipulative materials teaching has significance differences between mean achievement score. By the post-test results, the mean achievement score of the students in experimental group was increased than control group. So the use of manipulative materials has a positive effect on student's academic achievement.

Recommendations

The researcher found that if students are given the opportunity to use manipulative materials, they would learn and understand easily. The researcher also recommends that using manipulative materials gives students a better understanding of geometrical skills and seems to hold their interest and help them to enjoy learning. For more suggestion as follows,

- After starting the teaching learning activities teacher should be confident in how to use the manipulative materials and it should be connected with the related psychological or teaching strategies.
- Teacher should be trained and qualified for using manipulative materials.
- Teacher should be encouraged to use different manipulative materials in teaching geometry or other.
- Any geometric topic start by using manipulative materials it should be effective to provide the concept.

Suggestion for Further Study

On the basis of this study following suggestion have been put for further study;

- Such kind of research can be done on other level of school education.
- Similar study should be carried out with a large sample and various schools of different parts of Nepal.
- This type of research conducted in different topics of mathematics or other subject also.

Reference

Allsopp, D. H., Kyger, M. M., & Lovin, L. H. (2007). *Teaching Mathematics Meaningful*.London: Paul H. Brookes Publishing Co, Inc.

Amatya, B.P. (1978). *A Study of the Effectiveness of Teaching Mathematics with and without Use of Instructional Materials"*. An Unpublished Master Thesis.FOE, T.U,Kirtipur.

Bruner, J. S. (1990). *Act of Meaning*. Cambridge: Havard University Press.

Chaudhary, B.C. (2011*). Effectiveness of Instructional Materials on Teaching Menstruation at Secondary level."* An un Published Master Thesis.FOE, T.U., Kirtipur

Cole, M. (1996). *Cultural Psychology*. *A Once and Future Discipline*. Cambridge: The Belknap Press Harvard University Press.

Duncan, A. (1978). *Teaching Mathematics to Slow Learners*. London: The white friars Press.

Ghimire , H. K. (2005). *A Study on the Effectiveness of Teaching Algebra by using Models at Lower Secondary Level,* An Unpublished Master Thesis.FOE, T.U,Kirtipur.

Glasersfeld, E.von (1996).*Introduction; As Ipacts of Constructivism; Theory, Perspectives and Practices*, Ed. C.T. Fost not. New York, Teacher's Collage Press.

Hanna, G. (1986). *Sex Differences in Mathematics Achievement of Eight Grade in Ontario, Canada*; Journal for Research in Mathematics Education.

Hughes, M. (1986). *Children and Number. Difficulties in Learning Mathematics*. Oxford: Blackwell.Hunter, *Kindergarten Age Children.* Oslo: The Norwegian Institute for Special Education

Kirsch, I.S., Jungleblat, A., Jenkins, L., Kolstad, A. (1993). *A First Look at the Results of the* National Adualt Literacy Survey,Washington DC: National Center for educational statistics, U.S. Department of Education.

Lida, J. (2009). Teacher Variable and Students Mathematics Learning Related to Mnipulative use.

Naggar-Smith, N. (2008). *Teaching Foundation Mathematics. A Guide for Teachers of Older Students with Learning Difficulties*. London: Routledge.

Ostad, S. A. (1990). *Touch-Train-Learn. Basic Understanding of Mathematics When the Child Cannot See, Program for Teaching and Observation Directed Primarily.*

Ostad, S. A. (2001). *"Understanding and Handling Numbers" in* (Ed) Johnsen, B.H & Skjørten, M.D . (ed). *Education - Special Needs Education: An Introduction*. Pp.2003-224.

Pandey, H.B.(1995) *Use of Visual aids in Teaching Frication; Development of Teaching Model for teaching frecation in Grade VI,* An Unpublished Master Thesis.FOE, T.U,Kirtipur.

Rawat, K. H. (2011), *Effect of home environment on student's achievement in mathematics in secondary level: A case study on Kami students at Salyan district.* M.Ed. thesis, Faculty of Education, T.U., Kirtipur.

Reuhkala, M. (2001). *Mathematical Skills in Ninth-Graders: Relationship with Visual-*

Spatial Abilities and Working Memory, Educational Psychology. An International Journal of Experimental Educational Psychology, 21:4,387-399.

Rogoff, B. (2003). *The Cultural Nature of Human Development*. New York : Oxford University Press.

Sharma , S. N. (2001). *A Study on the Availability and use of Instructional Materials in Teaching Mathematics at* Cambridge, MA: Harvard University Press. *Vygotskian perspective on Cognitive Development*. (2002). Retrieved from

Shrestha, S. L. (2010).” *Effectivenesss of Instructional Materials on Teaching Menstruation at*

Sidhu, K. S. (1990). *The Teaching of mathematics.* New Delhi: Sterling Publishers Pvt. Ltd. *Secondary level.”* An Unpublished Master Thesis.FOE, T.U,Kirtipur.

Skemp, R. (1989). *Mathematics in the Primary School*. London: Routledge.

Street, B.V. (2005). *Understanding and Defining Literacy*: Background Paper prepared for the Education for all Global Monitoring Report 2006 Literacy for life. Paris: UNESCO

Thapa, B. (2016). Effectiveness of instructional Materials on Mathematics Achievement of Students.

Tiwari, P.T. (2014). Impact of Manipulative Materials in Teaching Mathematics at Basic Level.

Upadhaya, H. P. (2001). *The Effect of Monstructivism on Mathematics Achievement of Grade V Students of Nepal.* Dissertation Punjab University, India.

Upadhyay, H. P.(2003): *Teaching Mathematics.* Ratna Pustak Bhandar, Kathmandu.

Vygotsky, L. (1978*). Mind in Society: The Development of Higher Psychological Processes.*

http://edschool.csueastbay.edu/deparements/etleads/Chapter5SocialTheories.PDF

www.tumathed598.blogspot.com.(2072/11/17 B.S.)

Appendix- A

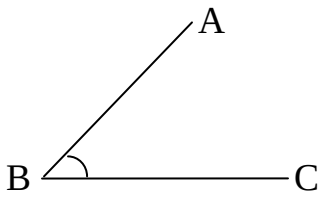
Achievement test Question for Pre- test

कक्षा - 5 पूर्णाङ्क - 50

विषय - गणित(ज्यामिती) उत्तिर्णाङ्क - 16

समूह - क (10×1=10)

1. प्रोटेक्टरको प्रयोग गरी तल दिईएको कोण ABC को नाप लेख .



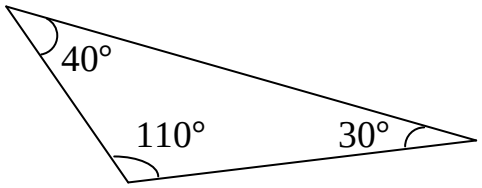
2. 90° भन्दा साना कोणलाई ..... कोण भनिन्छ ।

3. 90° भन्दा ठुला कोणलाई ..... कोण भनिन्छ ।

4. प्रोटेक्टरको सहायताले 60° को कोण खिच ।

5. कस्तो त्रिभुजलाई विषमबाहु त्रिभुज भनिन्छ ?

6. दिइएको त्रिभुज कस्तो त्रिभुज हो ?

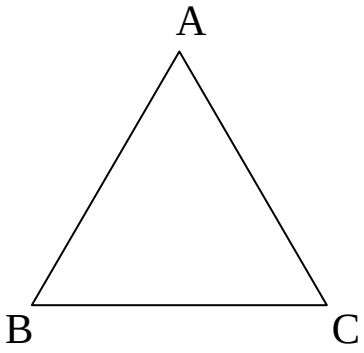


7. त्रिभुजको भित्री कोणहरुको योगफल कति हुन्छ ?

8. कस्तो प्रकारको त्रिभुजलाई समकोणि त्रिभुज भनिन्छ ?

9. यदि कुनै त्रिभुजको दुई ओटा भुजाहरु बराबर छन् भने त्यस्तो त्रिभुजलाई कुन त्रिभुज भनिन्छ ?

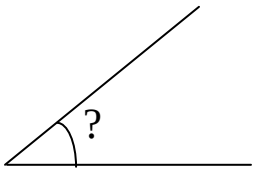
10. दिईएको त्रिभुजको तीनवटै भूजाहरु नापी ती भूजाको आधारमा उक्त त्रिभुजको नाम लेख ।



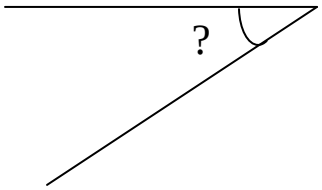
समूह - ख (10×2=20)

11. प्रोटेक्टरको सहायताले तल दिईएका कोणहरुको नाप लेख ।

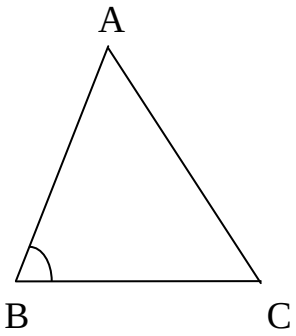
(a)



(b)



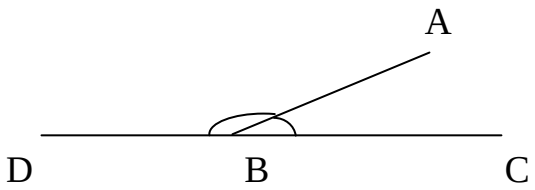
12. प्रोटेक्टरको सहायताले तल दिईएको त्रिभुजको कोण ABC को नाप लेख ।



13. समवाहु त्रिभुज र विषमवाहु त्रिभुज विचमा के फरक छ ? एउटा फरक लेख ।

14. प्रोटेक्टरको साहायताले 45° को कोण खिच ।

15. प्रोटेक्टरको प्रयोग गरी तल दिइएको कोण ABC र कोण ABD को नाप लेख ।

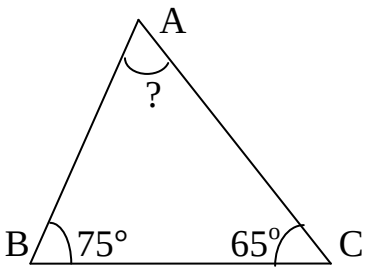


16. कोणको आधारमा त्रिभुजका प्रकारहरुको नाम लेख ।

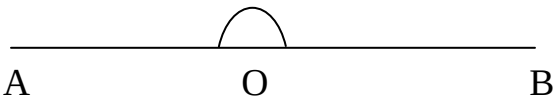
17. भुजाको आधारमा त्रिभुजका प्रकारहरुको नाम लेख ।

18. रुलर र प्रोटेक्टर प्रयोग गरी एउटा समकोणी त्रिभुज खिच ।

19. प्रोटेक्टरको प्रयोग नगरी तल दिइएको त्रिभुजको थाहा नभएको कोणको मान पत्ता लगाउ ।

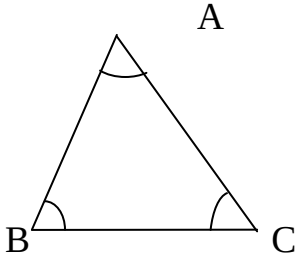


20. तल दिईएको कोणको नाप लेखि उक्त कोण कस्तो कोण हो ? नाम लेख ।



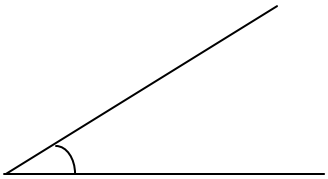
समूह - ग (5×4=20)

21. प्रोटेक्टरको सहायताले तल दिईएको त्रिभुजको प्रत्येक भित्री कोणहरु नापेर योगफल निकाल ।

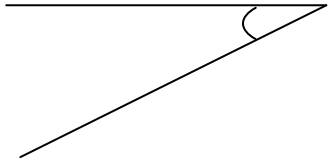


22. तल दिईएका कोणहरु नापी ती कोणहरु कुन कुन (समकोण, न्यूनकोण, अधिककोण वा सरलकोण) कोणहरु हुन् प्रत्येकको नाम लेख ।

(a)



(b)

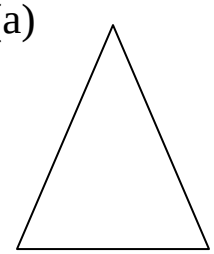


(c)

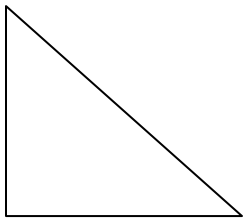
(d)

23. तल दिईएका प्रत्येक त्रिभुजको भूजाहरु नापी ती त्रिभुजहरु कुन कुन (समबाहु, समद्विबाहु, विसमबाहु) हुन् ? प्रत्येक त्रिभुजको नाम लेख ।

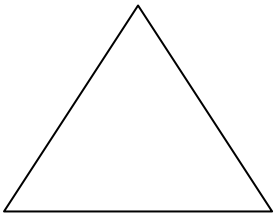
(a)



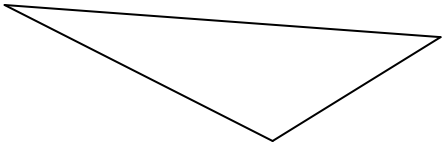
(b)



(c)

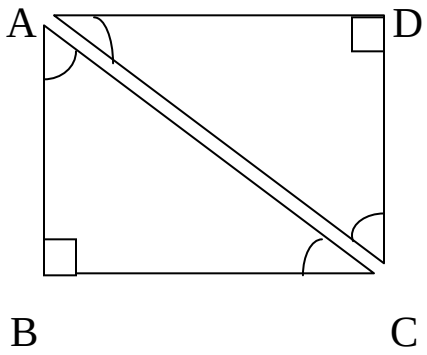


(d)

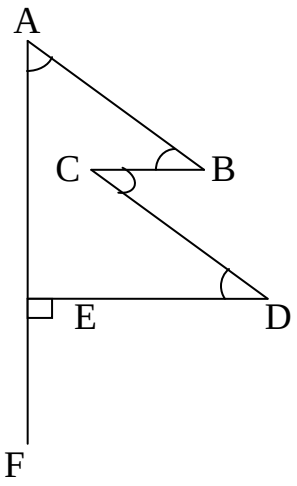


24. तल दिईएको एक जोडि त्रिभुजको भित्री कोणको नाप लेखी योगफल निकाल र दुबै

त्रिभुजको योगफल लाई जोड ।



25. प्रोटेक्टरको सहायताले नापेर तल चित्रमा दिइएको प्रत्येक कोणको नाप लेख ।



Appendix- B

Pre- test Score of the Students in Experimental and Control group

S.N.	Experimental group	Control group
1	33	35
2	20	31
3	25	16
4	31	25
5	19	28
6	13	13
7	12	14
8	16	19
9	17	24
10	24	15
11	15	10
12	18	27
13	28	26
14	27	20
15	25	23
16	17	21
17	20	18
18	21	12
19	23	17
20		24
21		24
22		13

Appendix-C

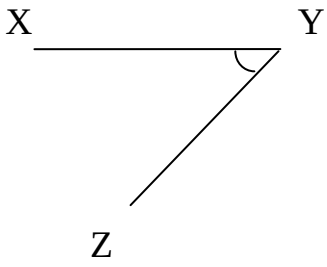
Achievement Test Items for Post Test

कक्षा - 5 पूर्णाङ्क - 50

विषय - गणित(ज्यामिती) उत्तिर्णाङ्क - 16

समूह - क (10×1=10)

1. प्रोटेक्टरको प्रयोग गरी तल दिईएको कोण XYZ को नाप लेख .



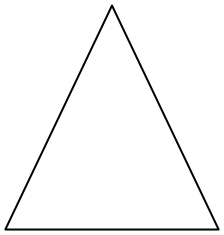
2. कति डिग्रीको कोणलाई समकोण भनिन्छ ?

3. 90° भन्दा ठुला कोणलाई ..... कोण भनिन्छ ।

4. प्रोटेक्टरको सहायताले 120° को कोण खिच ।

5. कस्तो त्रिभुजलाई समबाहु त्रिभुज भनिन्छ ?

6. दिइएको त्रिभुज कस्तो त्रिभुज हो ? (समबाहु, समद्विबाहु, विसमबमहु)

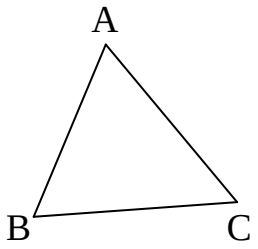


7. त्रिभुजको भित्री कोणहरुको योगफल कति हुन्छ ?

8. कस्तो प्रकारको त्रिभुजलाई समकोणि त्रिभुज भनिन्छ ?

9. यदि कुनै त्रिभुजको तीनवटै भुजाहरु बराबर छैनन् भने त्यस्तो त्रिभुजलाई कुन त्रिभुज भनिन्छ ?

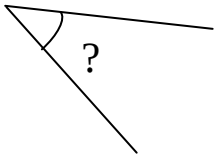
10. दिईएको त्रिभुजको तीनवटै भूजाहरु नापी ती भूजाको आधारमा उक्त त्रिभुजको नाम लेख ।



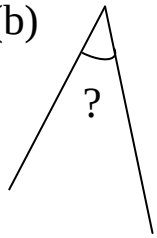
समूह - ख (10×2=20)

11. प्रोटेक्टरको सहायताले तल दिईएका कोणहरुको नाप लेख ।

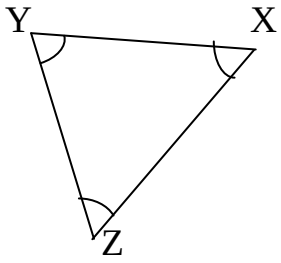
(a)



(b)



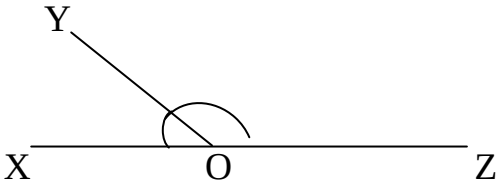
12. प्रोटेक्टरको सहायताले तल दिईएको त्रिभुजको कोण XYZ को नाप लेख ।



13. समद्विवाहु त्रिभुज र विषमवाहु त्रिभुज विचमा के फरक छ ? एउटा फरक लेख ।

14. प्रोटेक्टरको साहायताले 75°को कोण खिच ।

15. प्रोटेक्टरको प्रयोग गरी तल दिइएको कोण XOY र कोण YOZ को नाप लेख ।

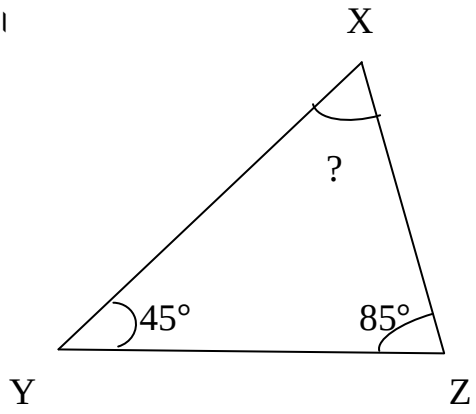


16. कोणको आधारमा त्रिभुजका प्रकारहरुको नाम लेख ।

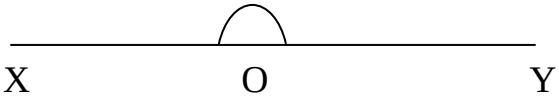
17. भुजाको आधारमा त्रिभुजका प्रकारहरुको नाम लेख ।

18. रुलर र प्रोटेक्टर प्रयोग गरी एउटा समकोणी त्रिभुज खिच ।

19. प्रोटेक्टरको प्रयोग नगरी तल दिइएको त्रिभुजको थाहा नभएको कोणको मान पत्ता लगाउ ।

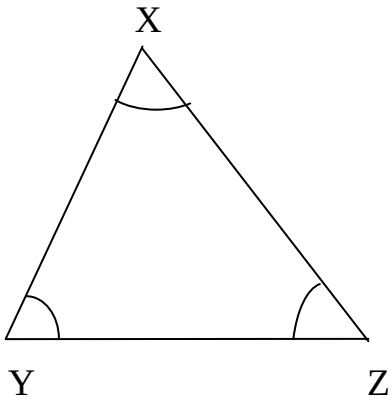


20. तल दिईएको कोणको नाप लेखि उक्त कोण कस्तो कोण हो ? नाम लेख ।

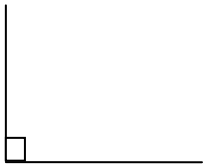


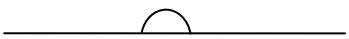
समूह - ग (5×4=20)

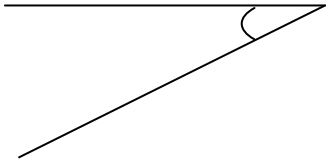
21. प्रोटेक्टरको सहायताले तल दिईएको त्रिभुजको प्रत्येक भित्री कोणहरु नापेर योगफल निकाल ।

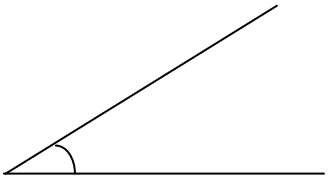


22. तल दिईएका कोणहरु नापी ती कोणहरु कुन कुन (समकोण, न्यूनकोण, अधिककोण वा सरलकोण) कोणहरु हुन् प्रत्येकको नाम लेख ।

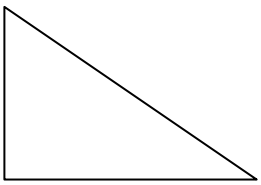
(a) 

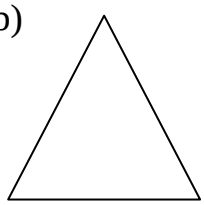
(b) 

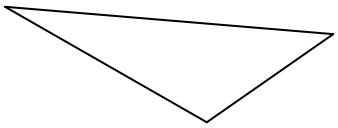
(c) 

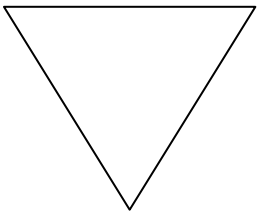
(d) 

23. तल दिईएका प्रत्येक त्रिभुजको भूजाहरु नापी ती त्रिभुजहरु कुन कुन (समबाहु, समद्विबाहु, विसमबाहु) हुन् ? प्रत्येक त्रिभुजको नाम लेख ।

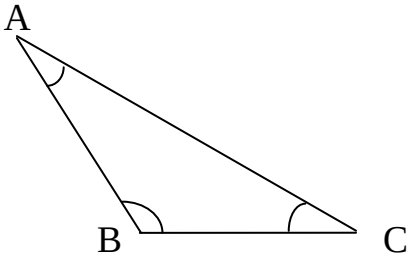
(a) 

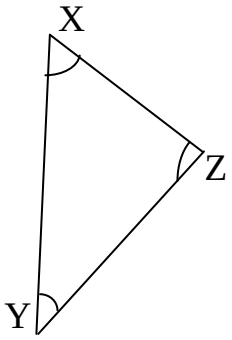
(b) 

(c) 

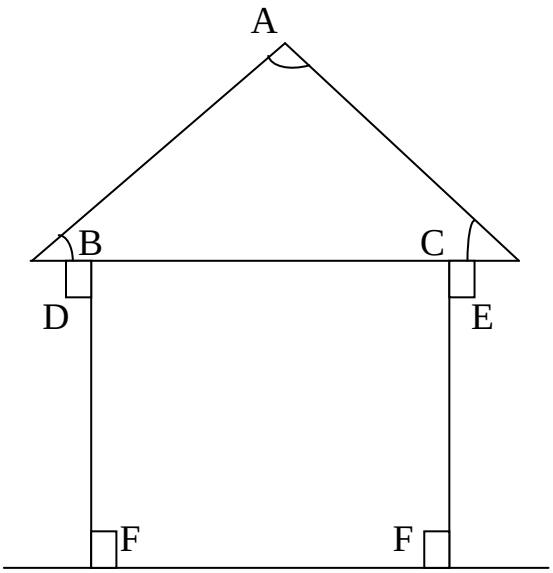
(d) 

24 तल दिईएको एक जोडि त्रिभुजको भित्री कोणको नाप लेखी योगफल निकाल र दुबै त्रिभुजको योगफल लाई जोड ।





25. प्रोटेक्टरको सहायताले नापेर तल चित्रमा दिइएको प्रत्येक कोणको नाप लेख ।



Appendix- D

Post- test Score of the Students in Experimental and Control Group

S.N.	Experimental group	Control group
1	43	39
2	32	35
3	35	20
4	39	27
5	29	30
6	20	13
7	16	21
8	16	25
9	25	21
10	31	20
11	27	16
12	35	27
13	38	23
14	30	29
15	29	16
16	26	21
17	31	25
18	38	19
19	20	17
20		21
21		30
22		15

APPENDIX-E

RELIABILITY CALCULATION

LEVEL	STUDENT	ODD	EVEN	SUM	DIFFERENCE
27% UPPER	A	23	24	47H	-1
	B	19	23	42H	-5L
	C	22	17	41H	5H
	D	20	12	22	8H
	E	20	25	46H	-2
	F	15	20	39	-1
	G	18	21	39	-3L
	H	17	11	28L	6H
	I	17	18	32	-1
27% LOWER	J	16	21	34	-5L
	K	20	17	35	3H
	L	13	14	30	2
	M	10	11	24L	2
	N	18	10	28L	2
	O	8	13	21L	-5L

Sum of four highest = 176 Sum of four highest of lower = 22

Sum of four lowest = 101 Sum of four lowest of lower = - 18

Difference Ds= 75 Difference D_d= -40

Square of Difference Ds^2= 5625 Square of Difference Dd^2= 1600

By formula: $= 1 - \frac{Dd^2}{Ds^2}$ = 0.71

Appendix-F

Statistical Formula Used in data Collection and Analysis

S.N.	Subject	Notation	Formula
1.	Mean	$\bar{X}$	$\frac{\sum fx}{N}$
2.	Variance	S^2	$\frac{\sum fx^2}{N} - \{\frac{\sum fd}{N}\}^2$
3.	t- test	t	$\frac{\bar{x_1} - \bar{x_2}}{\sqrt{\frac{(N1-1)S_1^2 + (N2-1)S_2^2}{N1+N2-2}\left(\frac{1}{N1}+\frac{1}{N2}\right)}}$ with $n_1 + n_2 - 2$ degree of freedom
4	Reliability	r_{tt}	$r_{tt} = 1 - \frac{Dd^2}{Ds^2}$

APPENDIX-G

TEACHING EPISOD FOR GEOMETRY IN GRADE FIVE

Episode - 1

Unit: Geometry **Class: 5**

Topic: Angle **Time: 45 Min.**

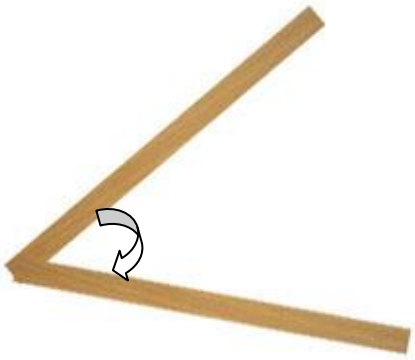
Specific Objectives:

- To give introduction of angle.

Materials: Wooden sticks, wall clock, geometry box.

Activities:

- First teacher will be made discussion about the pre knowledge about the angle.
- The teacher will show two fingers of hands where make the figure of angle, also make different angles through the wooden sticks as follows ;



- Discuss about examples of several angles in classroom, such as the angle between the wall, ceiling, wall clock, angle between fingers when they are spread out etc.

Evaluation:

- Write any three examples of angles.
- Draw any four angles on your copy.

Teaching episode - 2

Unit: Geometry **Class: 5**

Topic: Measurement of angle **Time: 45 Min.**

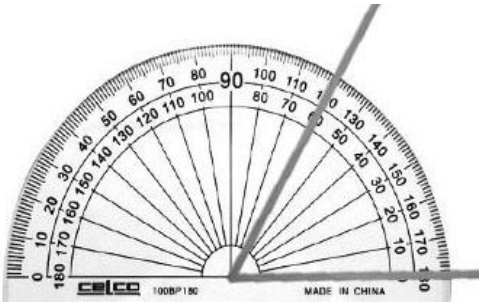
Specific Objectives:

- To measure the angle 0^0- 180^0.

Materials: protractor, wooden materials.

Activities:

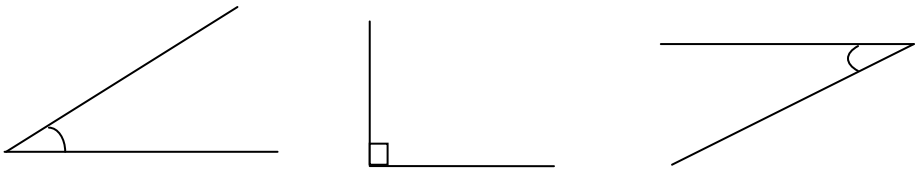
- First teacher will discuss about previous class.
- Teacher ask some questions ;
    - In which instruments measure the angle?
    - How to measure the angle?
- Teacher will show different parts of protractor like as midpoint, baseline
- Teacher will say about the measuring process with example. e.g.



- Teacher will provide the different angle and ask to students to measure the angles correctely and write the degree of each angle.

Evaluation:

- Measure the following angles and write their degree.



(a) (b) (c)

Teaching episode - 3

Unit: Geometry **Class: 5**

Topic: Measurement of angle **Time: 45 Min.**

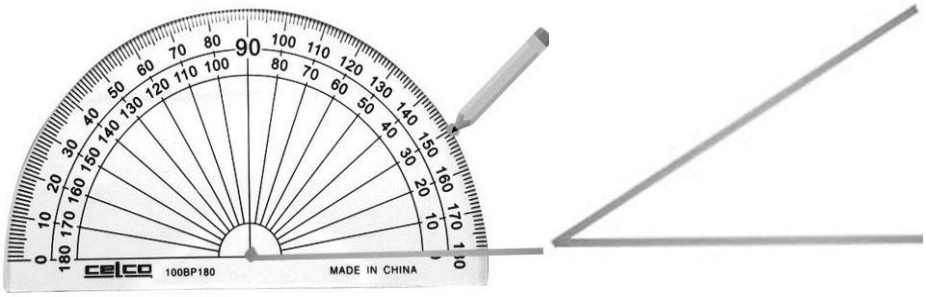
Specific Objectives:

- To Construct the angle 0^0- 180^0 .(by using protractor)

Materials: sticks, pencil, protractor and ruler.

Activities:

- First teacher will discuss about measuring process of angle.
- Teacher will ask to the students, How we construct the angle? Can we construct angle of 30^o or 60^o?
- Teacher will say, we can construct different angle through the protractor.
- After that teacher will describe about construct process through pencil by using protractor as like as;



- Teacher will provide the different degree of angle (e.g. 10^o , 20^o ,40^o ,60^o ,90^o) and ask to students to make the angle on your copy

Evaluations:

- Draw the following angles on your copy by the help of protractor.

  30^o, 60^o, 90^o, 150^o

Teaching episode - 4

Unit: Geometry **Class: 5**

Topic: Measurement of angle **Time: 45 Min.**

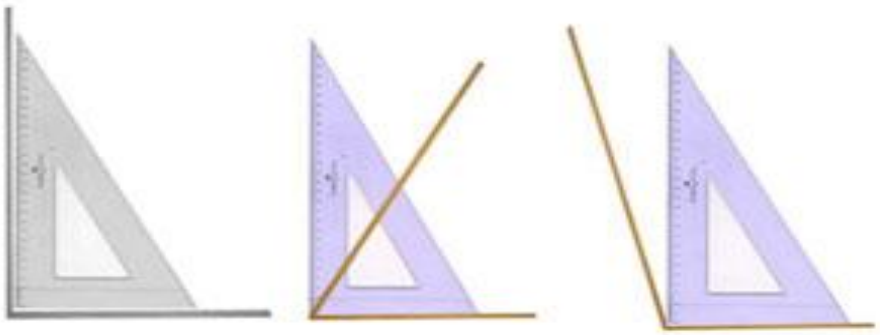
Specific Objectives:

- To identify the right angle, acute angle and obtuse angle.

Materials: setsquare protractor and different angle.

Activities:

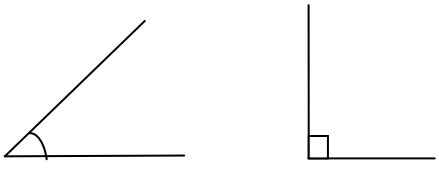
- First teacher will give introduction/describe about setsquare (e.g. setsquare is exactly 90^o etc.)
- Teacher will describe about technique or measuring process of setsquare.
- Teacher will measure the fowling angles and detect which is right angle or acute angle or obtuse angle



- Teacher will give different angle to students and ask to explore, which is right angle, acute angle or obtuse angle through the setsquare.

Evaluation:

- write the name of following angles by using setsquare



(a) (b) (c)

Teaching episode - 5

Unit: Geometry **Class: 5**

Topic: Triangle **Time: 45 Min.**

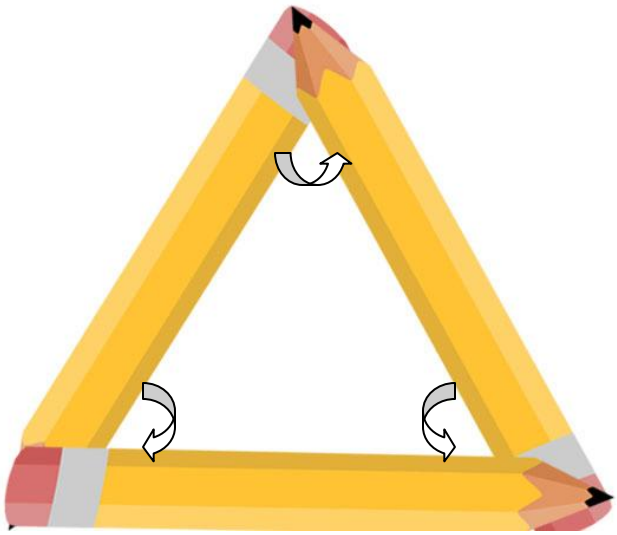
Specific Objectives:

- To define triangle.
- To measure sides of triangle correctly.

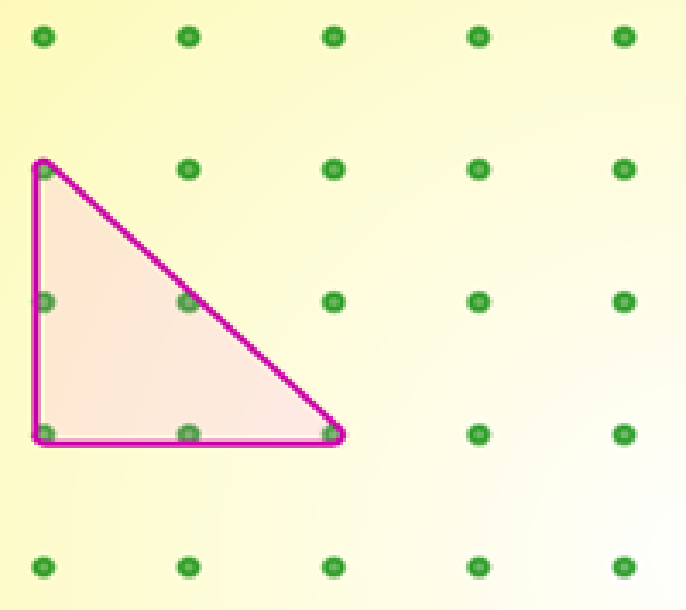
Materials: ruler, geoboard and rubber.

Activities:

- First teacher will be made discussion about the pre- knowledge of triangle.
- Asked the question what is triangle? How we measure the sides of any triangle by the help of ruler?
- After that teacher will define the triangle with example



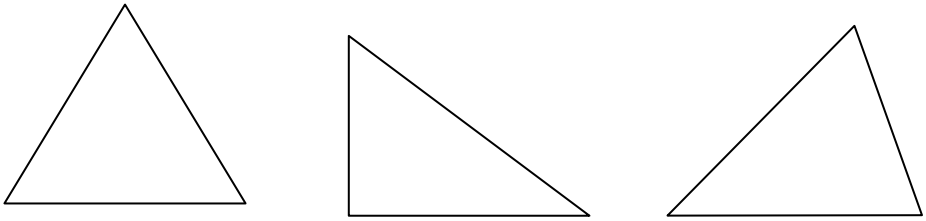
- Teacher will show the different shapes triangle in the class also draw triangle on white board.
- Also provide the clear concept of triangle construct of different types of triangles by using geo-board as follows;



- By the discussion with showing all students, teacher will measure the sides of different angles by the help of ruler.
- After that teacher will facilitate to all students for measure the sides of triangles their self.
- After that, students will be motivated to ask the questions about their confusing and provide the clear concept about how to measure sides of any triangle.

Evaluation:

- Define triangle with example.
- To measure the sides of the following triangle by using ruler.



(a) (b) (c)

Teaching episode - 6

Unit: Geometry **Class: 5**

Topic: Classification of triangle **Time: 45 Min.**

Specific Objectives:

- To classify the triangle by their sides.

Materials: ruler and classification chart of triangle.

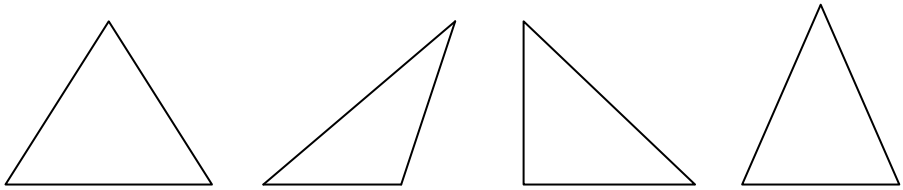
Activities:

- First teacher will be made discussion about the pre- knowledge of triangle.
- After that teacher will provides the different shapes triangle in the class and make discussion about the different between those triangles like as,

- By the discussion teacher will say about the different between the lengths of sides of the triangle and show the chart of classification of triangle by their sides.
- After that student will be motivate to ask the question about their confusion and provide the clear concept about the classification of the figure. Like as

Evaluation:

- Write the name of following triangle by measuring their sides



(a) (b) (c) (d)

Teaching episode - 7

Unit: Geometry **Class: 5**

Topic: Measurement of angle **Time: 45 Min.**

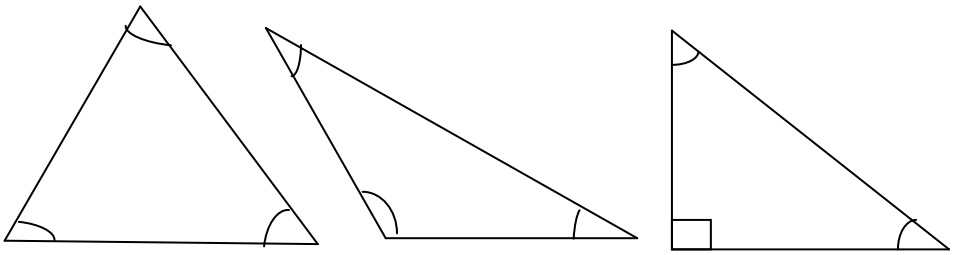
Specific Objective

- To measure the angle of any triangle right way.

Materials: protractor, different triangle.

Activities:

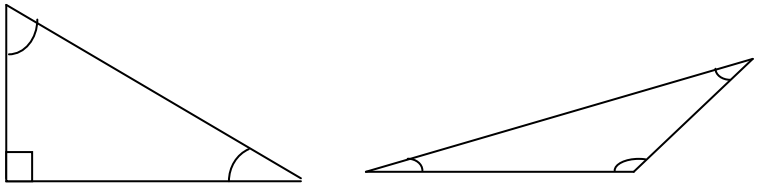
- First teacher will be made discussion about the pre-knowledge of triangle.
- Teacher will ask to the students about the knowledge of angle and ask how we measure the angle?
- After that teacher will show different triangle and measure the interior angle of each triangle with showing all students.



- Teacher will draw the different shapes triangle in the board and make discussion about the angle of each figure.
- After this teacher provides different triangle to all students and facilitate to measure each angle of triangle by the help of protractor.

Evaluation:

- Measure the following angles of triangles and write their degree.



Teaching episode - 8

Unit: Geometry **Class: 5**

Topic: Measurement of angle **Time: 45 Min.**

Specific Objectives:

- To identify the degree of any interior angle of triangle.

Materials: protractor, tangram

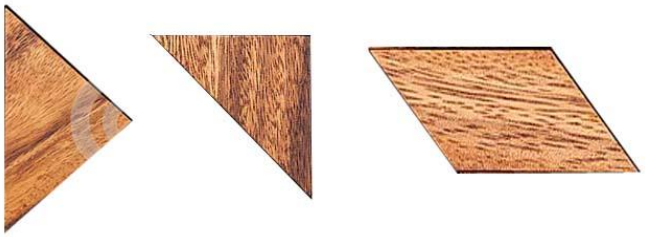
Activities:

- First teacher will discussion about the interior angle of any triangle.
- Teacher will discussion with the students about pre-knowledge, how to measuring interior angle of any triangle.
- Then teacher will suggest to the student how to measure the angle of figure.
- After that teacher will provide the different figure or the parts of tangram in different group and facilitate each group to measure the angles correctly and ask to students about degree of each interior angle

tangram

Evaluation:

- Measure the interior angle of following different pieces of tangram and write their degree.



Teaching episode - 9

Unit: Geometry **Class: 5**

Topic: Classification of triangle **Time: 45 Min.**

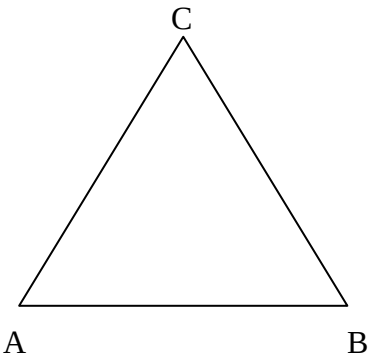
Specific Objectives:

- To classify the triangle by their angle.

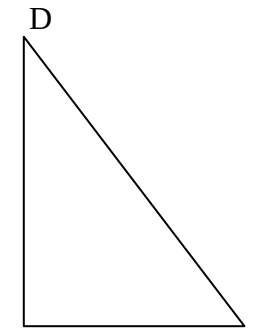
Materials: ruler, classification chart of triangle and protractor

Activities:

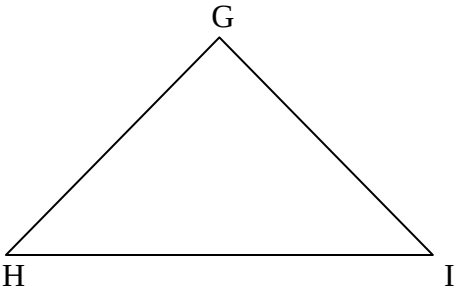
- First teacher will be made discussion about the pre- knowledge of triangle.
- Asked about the knowledge of angle and ask how we classified the triangle by their angles?
- After that teacher will draw the different shapes triangle in the board and make discussion about the different between those figure like as,



(I)



(II)



(III)

- By the discussion, start to measure the angle by using the protractor in the board. Like as,

In figure one

$\angle A = 70^0$ $\angle B = 60^0$ $\angle C = 50^0$

By measuring the angle of triangle all the angles are less than 90^0 then the triangle is acute angle triangle.

In figure two,

$\angle E = 90^0$ $\angle F = 45^0$ $\angle A = 45^0$

In this triangle one of the angle is 90^0 so this triangle is called the right angle triangle.

In figure third;

$\angle G = 40^0$ $\angle H = 35^0$ $\angle I = 105^0$

In this triangle one of the angle is greater than 90^0 so this triangle is called the obtuse angle triangle.

- Finally teacher will ask to the students about the classification triangle by their angle and provide the clear concept about it.

Evaluation:

- Classify the following triangles on the basis of their angles.

Teaching episode -10

Unit: Geometry **Class: 5**

Topic: Classification of triangle **Time: 45 Min.**

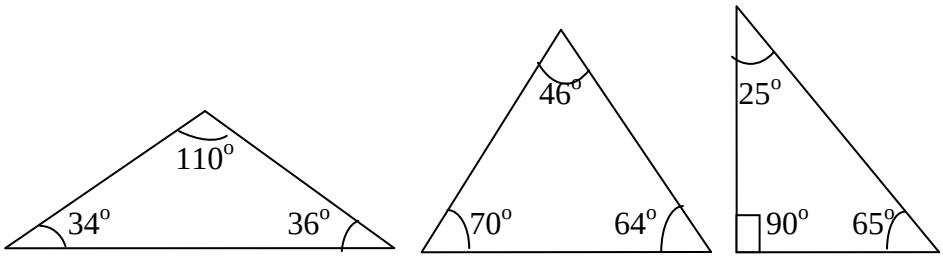
Specific Objectives:

- To identify the degree of angle of triangle and classify theirs.

Materials: ruler, protractor and different triangle.

Activities:

- First teacher will activate and encourage the students to memorize the previous class activity and forward the class.
- Teacher will explain and discuss with the help of students and make exercise on the topic.
- The related exercise in the book will be solved in a group of student and teacher will check the result of the problem.
- After that teacher asked some question about the exercise and say how you classify the triangle? The triangle having one angle greater than 90 degree, such types of triangle is acute obtuse and right angle triangle or what?
- By discussion on the exercise then teacher will asked clearly about the problem and then make a triangle in the board and ask to say their types by their angle like as,



Evaluation:

- Do Q. No. 2 of exercise 1.2 from your textbook.

Teaching episode - 11

Unit: Geometry **Class: 5**

Topic: Sum of interior angle of triangle **Time: 45 Min.**

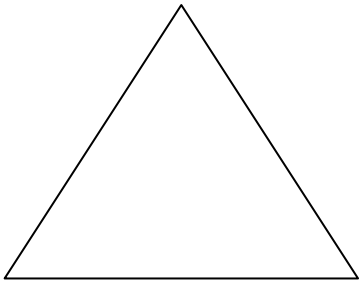
Specific Objectives:

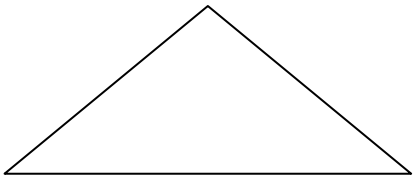
- To find out the sum interior angle of triangle.
- To say the sum of interior angle of all types triangle is 180^0.

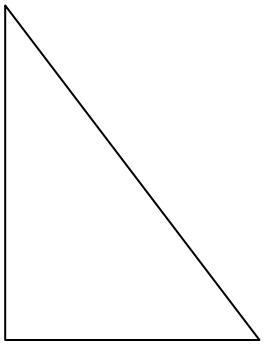
Materials: ruler, protractor and different triangles.

Activities:

- First teacher will make the student mentally prepare then ask some question as follows;
    - Do you know about the sum of interior angle of triangle?
    - Do you try to calculate the sum of interior angle of triangle?
    - How we calculate the sum of interior angle of triangle?
    - Can you guess about the angle of triangle?
- Discussion about the question will be made with the student and try to calculate the sum of triangles interior angles.
- For real practice give four triangular part of ten gram to the student and say to measure each angle by protractor and write the degree of each and sum three angles.
- After that to say the total sum of the angle of triangle if any group make fault then again try to measure the angle and say the sum of angle of triangle is always equal to 180^0.
- Again for individually try to calculate the sum of angle of triangle, such types of triangle say to make, on their copy like as,



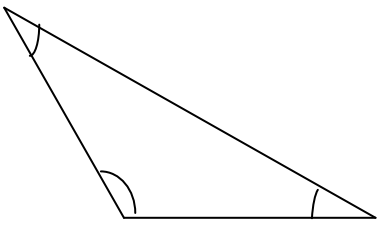


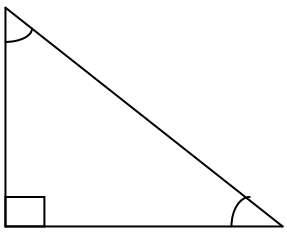


- After the drawing the figure, say to measure the angle of triangle one by one and say to sum of three angle of one triangle. And this process continues for two three triangles and to say the sum of the triangles angle they say the entire sum is equal to 180^0. Thus this shows that the sum of angle of triangle is equal to 180^0.

Evaluation:

- What is the sum of interior angle of any triangle?
- Find out the sum of interior angles of following triangles.





Teaching episode - 12

Unit: Geometry **Class: 5**

Topic: Sum of interior angle of triangle **Time: 45 min.**

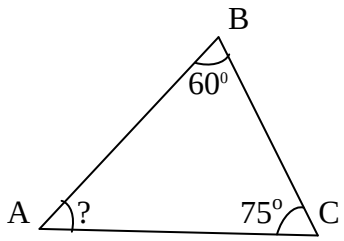
Specific Objectives:

- To find out the reaming angle without protractor where two angle are given in any triangle.

Materials: different triangles

Activities:

- First teacher will discuss about pre-knowledge of sum interior angle of any triangle.
- After that teacher will show the figure as follows and discuss about it, what are given and what is to find;



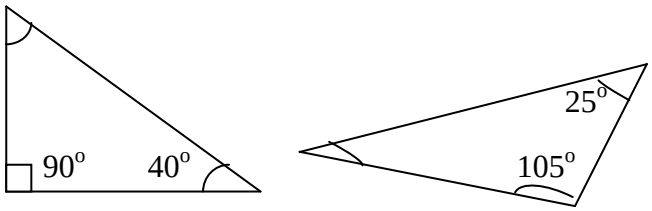
- Again teacher ask, what is the sum of interior angle of triangle ?
- Then teacher write $60^o + 75^o + \measuredangle A = 180^o$ on board and ask question about it, how $60^o + 75^o + \measuredangle A = 180^o$? Then teacher clarify about it.

  $60^o + 75^o + \measuredangle A = 180^o$

  Thus, $A = 45^o$ (which is reaming angle)

Evaluation:

- Find out the reaming angles of following triangles without using protractor.



Teaching episode - 13

Unit: Geometry **Class: 5**

Topic: Sum of interior angle of quadrilateral. **Time: 45 min.**

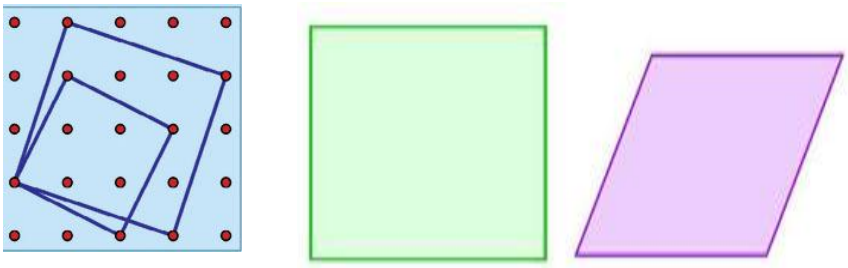
Specific objectives:

- To find out the sum of interior angle of quadrilateral.
- To say the sum of interior angle of all types quadrilateral is 360^o.

Materials: geoboard, rubber, protractor and different quadrilateral.

Activities:

- First teacher will be discussion about the pre knowledge of quadrilateral.
- Teacher ask some question to the students as follows;
  - What is quadrilateral?
  - Can you make quadrilateral?
  - Can you guess about sum of the interior angle of quadrilateral?
  - Do you try to calculate the sun of interior angle of quadrilateral?
- After that teacher will define quadrilateral with example and explain about measuring process.



- After that teacher will give quadrilateral to the students and say to measure each angle by protractor and write the degree of each and sum four angles.
- After that clarify that the total sum of interior angle of quadrilateral is 360^o

Evaluation:

- Draw three different quadrilaterals on your copy and find the sum of interior angle of theses.

Teaching episode - 14

Unit: Geometry **Class: 5**

Topic: Sum of interior angle of quadrilateral. **Time: 45 min.**

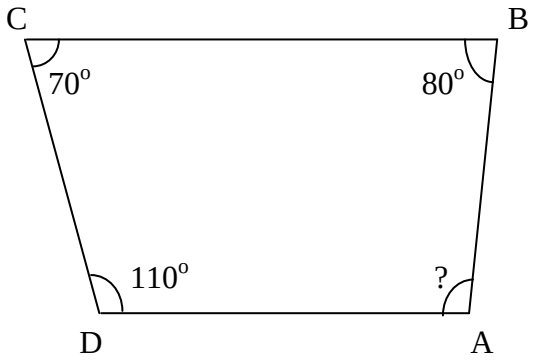
Specific objectives:

- To find out the reaming angle without protractor where three angles are given in any quadrilateral.

Materials: different quadrilateral.

Activities:

- First teacher will discuss about pre knowledge of total sum of interior angle of any quadrilateral.
- After that teacher will show the quadrilateral as follows and discuss about it, what are given and what is to find?



- Teacher will ask, what is the sum of interior angle of quadrilateral?
- Teacher will discuss, how to calculate the reaming angle
- Teacher write $\measuredangle 110^o + \measuredangle 70^o + \measuredangle 80^o + \measuredangle A^o = 360^o$

  Thus, $\measuredangle A = 100^o$.

Evaluation:

- Find out reaming angle of quadrilateral.