Chapter I

INTRODUCTION

Background of the Study

The major influence on the development of school mathematics curriculum, instruction and research is due to the perceptions of the nature and role of mathematics in our society. "Understanding of the different concepts of the mathematics is important to the development and successful implementation program in school mathematics as it is to conduct and interpretation of the research studies" (Dossey, 1992 p. 36).

Teaching is an art. It does require the knowledge. From the past, many teachers have tried to help their pupils for learning. Successful of the teachers depends upon knowing the kind of help the individual child requires, as much help as the child needs at a given time, strategic timing if help, the amount and quality of resource available for use and the qualification of the those who did give help. The day-to- day mathematics learning is becoming harder and harder as compared to other subjects. There is a problem of mathematics teacher, to solve this problem the discipline of mathematics education was established as a consequence (Lyon Congress, 1969).

Collaborative learning is an umbrella term for a variety of educational approaches involving joint intellectual effort by students, or students and teachers together. Usually, students are working in groups of two or more, mutually searching for understanding, solutions, or meanings, or creating a product. Collaborative learning activities vary widely, but most center on students' exploration or application of the course material, not simply the teacher's presentation or explication of it. Collaborative learning represents a significant shift away from the typical teacher centered or lecture-centered milieu in college classrooms.

Teachers who use collaborative learning approaches tend to think of themselves less as expert transmitters of knowledge to students, and more as expert designers of intellectual experiences for students-as coaches or midwives of a more emergent learning process, (Barbara Leigh Smith and Jean.T.MacGregor 1990). In traditional learning, instructors give lecture to make their foundation strong and learner learn individually in their home also. (Myers,1975) points out that dictionary definitions of "collaboration" derived from its Latin root, focus on the process of working British roots, based on the work of English teachers exploring ways to help students respond to literature by taking a more active role in their own learning. The cooperative learning tradition tends to use quantitative methods which look at achievement i.e. the product of learning. The collaborative learning tradition takes a more qualitative approach, analyzing student talk in response to a piece of literature or a primary source in history.

Myers points out some differences between two concepts: "Supporters of individual learning tend to be more teachers centered. Collaborative learning advocates distrust and allow students say more if forming friendship and interest groups. Student talk is stressed as a means for working things out. Discovery and contextual approaches are used to teach interpersonal skills. Such differences can lead to disagreements. Researcher contends the dispute is not about research, but more about the morality of what should happen in the schools. Beliefs as to what should happen in the schools can be viewed as a continuum of orientations toward curriculum from "transmission" to transaction" to "transmission".

At one end is the transmission position, as the name suggests, the aim of this orientation is to transmit knowledge to the students in the form of facts, skills and values. The transformation position at the other end of the continuum stresses

personal and social change in which the person is said to be interrelated with the environment rather than having control over it. The aim of this orientation is self-actualization, personal or organizational change" (p. 12),

In collaborative learning, instructor helps students to solve the problems involving actively on their work. Learners make group and discuss in each topic made their understanding by themselves in a group. Researcher is getting closer to researcher's elusive goal all the time. Collaborative Learning has been widely known as the most effective form of leaning (Yun, 2006). The underlying premise for collaborative is founded in constructivist epistemology. "Learning is enhanced when it is more like a team effort than a solo race. Good learning, like good work, is collaborative and social, not competitive and isolated. Sharing one's ideas and responding to others' improves thinking and deepens understanding" (Wiersema, 2000).

Johnson and Smith (1991) have summarized these principles in their definition of a new paradigm of teaching. First, knowledge is constructed discovered and transformed by students. Faculty create the conditions within which students can construct meaning from the material studied by processing it through existing cognitive structures and then retaining it in long–term memory where it remains open to further processing and possible reconstruction. Second, students actively construct their own knowledge. Learning is conceived of as something a learner does, not something that is done to the learner. Students do not passively accept knowledge from the teacher or curriculum. Students activate their existing cognitive structures or construct new ones to subsume the new input. Third, faculty effort is aimed at developing student's competencies and between the faculty and students as they work together. Fifth, all of the above can only take place within a cooperative context.

Sixth, teaching is assumed to be a complex application of theory and research that requires considerable teacher training and continuous refinement of skills and procedures (Johnson, Johnson & Smith 1991, p. 75). Children actively construct their mathematical understandings as they participate in classroom social processes (Cobb et.al, 1997 in Clark. et. al., 2005).

On the basis of above discussion, the underlying premise of collaborative learning is founded in constructivist theory. Knowledge is discovered by students and transformed into concepts students can relate to. It is than reconstructed and expanded through new learning experiences. Learning consists of active participation by the student versus passive acceptance of information presented by an expert lecturer. Learning comes about through transactions and dialogue among students and between faculty and students, in a social setting. Students learn to understand and appreciate different perspectives through a dialogue with their peers. A dialogue with the teacher helps students to learn the vocabulary and social structures which govern the group's students wish to join, such as historian, mathematician, writer, actor, etc.

Collaboration is a philosophy of interaction and personal lifestyle where individuals are responsible for their actions, including learning and respect the abilities and contributions of their peers: individual is a structure of internalization of knowledge designed to facilitate the accomplishment of a specific end product or goal through people working individually. Before we proceed with the theoretical underpinning of each method it would be helpful to describe the differences between the two paradigms in terms of an actual class. In the collaborative model groups would assume almost total responsibility for answering the question. If not they identify other sources, such as journals, books, videos, the internet, etc. The work of

obtaining the extra source material would be distributed among the group members by the group members. The group would decide how many reasons they could identify.

The collaborative teacher would not specify a reason, but would assess the progress of each group and provide suggestions about each group's approach and the data generated. It might also occur to the students to list the reasons in order of priority. The teacher would be available for consultations and facilitate the process by asking for frequent progress reports from the groups frequently, facilitate groups frequently, facilitate group discussions group dynamics, which help with conflict resolution, etc. the final conclusion is determined by each group, after consultation with the teacher. Broby and Davids (1998) look at the differences between the two paradigms epistemological. In the early 1970s some educators were formulating methods based upon studies of human social interaction and group learning.

These studies lead to cooperative learning strategies based upon social interdependence theory. Another group of educators based their framework for group working on theories derived from students about the basis of collaborative learning. If learners can be "confidents in their individually, yet enriched by their collaborations with colleagues, then the result may be truly empowered individuals." As one student wrote, "The supportive environment helps us become more outgoing, encouraging and sociable helps us become more of who we want to be. We are all very different, with individual need, strengths, and weaknesses. Yet, we have been able to find common ground, appreciate each other and find a place for all our voices" (Rolheiser humdey, Gooding 1991 as cited in Bennert Rolheieser Stevahn 1991p.108).

From the above citation is clear that traditional learning is also one of the good approaches of teaching learning procedure. Johnson, Johnson and Smith (1998) clarify the differences between the individual learning strategies. "Social

interdependence theory assumes that individual efforts are based on intrinsic motivation generated by interpersonal factors and a joint aspiration achieves a significant goal. Behavioral learning theory assumes that cooperative efforts are powered by extrinsic motivation to achieve rewards. Social interdependence theory focuses on relational concepts dealing with what happens among individuals.

Statement of the Problem

This study has mainly concerned about the effectiveness of the collaborative learning verses traditional learning. In traditional learning system there use only teacher's centered method or rote learning, such as students are not interested in teaching learning activities thus, the result seem low achievement. Nowadays, "how to increase the number of students and quality of achievement in teaching learning activities" is an issue, for this it is important to invent new method in teaching learning activities. Such that the collaborating teaching method was founded as new method. It is assumed that the newly practiced method is more effective than traditional. So the researcher was interested for sighted difference between traditional and collaborative learning in the context of our country. In this research, the researcher tried to answer the following questions:

- Are there any significant differences between the achievement of the students with and without using collaborative learning approach?
- Is there any difference on the behavior of students during and after experiment?

Significance of the Study

The subject of mathematics is the useful tool for other relevant subject e. g. vocational training and highly specialized courses of learning. The main theme of teaching mathematics is not the acquisition of knowledge but the acquirement of the

power acquiring knowledge because acquisition of knowledge is concerned only with the product of knowledge and the power of acquiring knowledge is concern with process of knowledge which gives the power of acquiring knowledge.

This study has the following significances in the teaching and learning of mathematics.

- It helps the teacher to organize his/ her experiences in appropriate learning strategies.
- It helps to develop an effective instructional planning.
- It gives a model of innovative instructional planning and learning.
- It gives the chance to observe behave of students after experiment.

Objectives of the Study

The objectives of this study were as follows:

- To compare the achievement of students in collaborative learning and traditional learning in mathematics.
- To analyze the behavior of students during and after experimentation.

Delimitation of the Study

There are various factors which influence the research. Some of these are bellows:

- This study was limited in Gandhi Adarsha Secondary School, Bhaktapur, Gothatar.
- This study was limited to the students of grade nine.
- This study was limited to the topic of matrix.
- This study was limited to compute the achievement between control group and experimental group. Moreover, researcher had tried to find out change in behaviors after experimentation.

Definition of Terms

Effectiveness

Effectiveness is the capability of producing a desired result which refers to doing the right thing.

Collaborative Learning

Collaborative learning is a situation in which two or more people learn or attempt to learn something together and more specially as joint problem solving.

Traditional Learning

Traditional learning is mainly guided by chalk and talk methodology of teaching and the aim of education is basically based upon the transfer of knowledge.

Achievement score

The achievement of the score obtained by the students in achievement test of secondary school mathematics construct by the investigator.

Instruction

In this research, 'Instruction' leads teaching learning activities and teaching method in both experimental and controlled group.

Experimental Group

In this research, experimental group define as which group taught by using collaborative learning method.

Control Group

In this research, control group define as which group taught by using traditional teaching method.

Chapter II

REVIEW OF RELATED LITERATURE

"A literature review is a classification and evaluation of what accredited scholars and researches have written on a topic." Hence a literature not only arranges the literatures together, but also classifies and organizes them into subtopics. Nicholas Walliman (2006) in Pant (2005) stated, "A literature review (or overview) is a summary and analysis of current knowledge about a particular topic or area of enquiry." So besides locating, organizing and classifying the literatures, it is also the summary making and analysis of the contemporary knowledge on the same research issue.

This chapter is deals with literatures related to effectiveness of collaborative method in mathematics learning. It is discuss the various studies carried out by the scholars. The main objective of literature review was gain familiarity with subject matter to get enough knowledge to develop conceptual framework and to validate the concepts and to adopt appropriate research methods.

Empirical Literature

K.C. (2006) did experimental research about the effectiveness of teaching learning mathematics in cooperative method focused on geometry in primary section. So he prepared two groups of homogenous groups and conducted an experiment. He analyzed the statistical data by using t-test of 0.05 level of significant. He found that learning mathematics through cooperation is more effective than traditional learning method.

Ghimire (2001) did a research on "A study on the effectiveness of experimental verification in teaching the deductive proofs of geometric theorems secondary level" with the aim to study the effect of prior use of experimental

verification in proving geometric theorems and enhancement of understanding the facts, principles and concept of geometric ideas. Posttest only equivalent group was adopted. He taught both the groups on the same selected units of grade Ix geometry. The researcher made achievement test. The t-test and f-test were applied and concluded that experimental verification has significant effect on teaching geometry.

Rout (2000) did an experimental research on "A study on the effectiveness of inductive-deductive teaching learning approach in secondary school" with the aim to compare the achievement of students taught by inductive-deductive approach to the achievement of students by tradition approach and to determine effective approach of suitable class room teaching learning in the secondary school. A pretest-posttest equivalent group design was adopted to conduct the experiment in the content equation and inequality for grade nine for eight weeks. An achievement test of 30 items was administered and F-test, t-test, correlation coefficient analysis were used and conclude that the achievement of the students taught by inductor-deductive approach of teaching improve significantly better achievement than the performance of students taught by traditional approach.

Neupane (2001) did an experimental research on "A study on the effectiveness of play way method in mathematics teaching at primary level" with the aims to explore the effectiveness of the play method of teaching mathematics at primary level and to compare the achievement of students taught by play-way method verses traditional learning. A pretest-posttest equivalent group design was adopted. The researcher developed an achievement test. Two schools were sampled. The t-test was applied and concluded that the play-way method resulted significantly better method over traditional learning of teaching at primary level.

Bhusal (2000) did a research on "A study on the effectiveness of teaching geometry using discovery module and expository module of teaching in secondary level." With the aim to find out whether the discovery module of teaching in geometry is more useful than expository to prove geometrical theorems as well as to compare the achievement between the group of the students taught by using discovery and expository model of teaching. They were taught for 3 weeks. The t-test was applied to draw conclusion that the discovery method is better than expository method in teaching geometry.

Theoretical Framework

When I went though Taylor (1997) I found that there are several approaches in the collaborative learning and all of them that apply students lined experience from which they continues to learn. Collaborative learning is mostly defined as "A situation in which two or more people learn or attempt learn something and more specially as joint problem solving (Dillenbourg,1996,p.1). Roschelle and Teasly advocated collaborative more especially as" mutually engagement of participation in a coordinated effort to solve a problem together", as cited in (Dilenbourg et al 1996, p.d). In collaborative approach we work together to accomplish shared goals.

The effects of an individual help not only the individual to be rewarded, but also others in the class. Language acquisition is facilitated by students interdicting in the target language. Responsibility and accountability for each other's learning is shaded. The teachers give feedback on the tasks from a tasks based approach to language instruction for instanced cooperative learning is similar to learner strategy tainting as well in that both require language to teach other skills in addition to teachings languages.

Collaborative learning is rooted in Lev Vygotsky's concept of learning called zone of proximal development. Typically there are tasks learners can accomplish and tasks learners cannot accomplish. Between these two areas is the zone of proximal development, which is a category of things that a learner can learn but with the help of guidance. The zone of proximal development gives guidance as to what set of skills a learner has that are in the process of maturation. In Vygotsky's definition of zone of proximal development, he highlighted the importance of learning through communication and interactions with others rather than just through independent work. This has made way for the ideas of group learning, one of which being collaborative learning.

Dillenbourg (1999, p. 1) gives a global definition to Collaborative Learning as a "situation in which two or more people learn or attempt to learn something together." In this definition, as italicized, "two or more people" can be interpreted as a pair, a small group with three to five learners, a class of 20–30 students, a community of a few hundred or thousand people, or a society of several thousand or millions of people. "Learn," indicates the attendance to a course, a study of the teaching materials, a participation in the learning activities, or the accumulation of lifelong work practice. "Together" con notes the various types of social interaction, such as face-to- face interaction, interaction mediated by computer, whether or not it is a truly joint achievement, and if the work is arranged in a systematic way (Dillenbourg 1999).

Fengfeng &Barbara(2007) study about the game playing for mathematics learning cooperative or not? They took grade v multivariate students and they taught them through play way method. Their findings were investigated the effects of game playing on fifth-graders mathematics performance and attitudes. One hundred twenty

five fifth graders were recruited and assigned to a cooperative team-games-tournament (TGT), interpersonal competitive or no game playing condition. A state standards-based mathematics exam and an inventory on attitudes towards mathematics were used for the pretest and posttest. The students' gender, socio-economic status and prior mathematics ability were examined as the moderating variables and covariate. Multivariate analysis of covariance (MANCOVA) indicated that game playing was more effective than drills in promoting mathematics performance, and cooperative game playing was most effective for promoting positive mathematics attitudes regardless of students' individual differences.

Pokhrel (2006) studied in teacher education program and in the students of grade IX with an action research and published an article as a journey of mathematic educator from his student life in school to the life of educator. How teaching and learning of mathematics was practiced in the past and how this done at present is highlighted in the history particularly concerned in the past learning culture developed in school in the past and in the present legacy. How far the used of cooperative learning possible in Nepalese context in course of mathematics teaching and educating teachers are discussed on the basis of an action research of the writer. The research, is people generally, understand a high sounding meaning, but it is the result of implementers' research intervening something in a situation. The study of writer showed that cooperative learning is possible to introduce in Nepalese context with slight modification in the approach. This creates positive thinking and hope in the improvement of mathematics education in Nepal.

Collaborative learning

Collaborative learning is a situation in which two or more people learn or attempt to learn something together. More specifically, collaborative learning is based

on the model that knowledge can be created within a population where members actively interact by sharing experiences and take on asymmetry roles. In which learners engage in a common task where each individual depends on and is accountable to each other. These include both face-to-face conversations.

Collaborative learning activities can include collaborative writing, group projects, joint problem solving, debates, study teams, and other activities. Collaborative learning is very important in achieving critical thinking. Often, collaborative learning is used as an umbrella term for a variety of approaches in education that involve joint intellectual effort by students or students and teachers by engaging individuals in interdependent learning activities.

There were several procedures to teach students by collaborative method. Such as group investigation, Learning together (LT), Academic controversy, Team-Game-Tournaments (TGT), students Team Achievement Division (STAD) etc. However, researcher selected Student's Team Achievements Division (STAD) method to teach the experimental group because it is the simple of all other method.

STAD (Students Team Achievement Division)

STAD is a cooperative teaching method which was developed by Slavin (1978) as part of a student learning approach program along with other cooperative methods such as Teams-Games-Tournaments, Jigsaw II (Slavin 1980), and Team Assisted Individualization (Slavin et al. 1981). In STAD, students are assigned to four- or five-member learning teams. The teams are composed of high, average, and low performing students, and of boys and girls of different racial or ethnic backgrounds. Thus, each team is a microcosm of the entire class. There are five main steps a teacher should follow when STAD is implemented.

In STAD, detailed steps are as follows:

- Class Presentations.

The teacher presents the material in front of the class in the classical style that focuses on the concepts of matter to be discussed only. Furthermore, students are asked to learn in small groups to work on tasks assigned by the teacher.

- The formation of study groups (Teams).

Students are organized into groups whose members are heterogeneous (both academic ability and gender). The trick with rank students based on grades or the last value obtained before the student STAD cooperative learning models. The function of this grouping is to encourage cooperation in the group study the material and complete the tasks assigned by the teacher.

- Provision of test or quiz (Quizzes).

After studying the group completed the test, quiz was held with the objective of identifying, or the ability to measure student learning of the material has been studied. In this case, the student was not allowed to work with his friend. The purpose of this test is to motivate students to try and individually responsible. Students are required to do my best as a result of group learning. In addition to individual responsibility, the students also have to realize that businesses and their success will be very valuable to contribute to the success of the group. This test is performed after one to two servings of classes and learning in groups.

- Improved scoring individual (Individual Improvement Scores).

This is done to give the students a goal that can be achieved if they work hard and showed good results compared with previous results. Manager scores the results of the cooperation of students performed in the following order: score early, score tests, and score of the group increased.

- Awards group (Team Recognition) award is given to the group to give a gift in appreciation of the efforts that have been made during the study. (Slavin, 1995 in Prilatama, 2008).

STAD (Students team achievement division) according to Rai (2007) is one of the many strategies in cooperative learning, which helps promote collaboration and self-regulating learning skills. The reason for the selection of STAD is good interaction among students, improve positive attitude towards subject, better self-esteem, increased interpersonal skills. STAD also add an extra source of learning within the groups because some high achievers act as a role of tutor, which result in high achievements. Finally, it enables the students according to the requirements of the modern society by teaching them to work with their colleagues competently and successfully as explained by Balfakih (2003). The findings of Balfakih (2003) have indicated that in teaching 10th grade chemistry, students team achievements division (STAD) is a more effective teaching method than the traditional-learning method.

Reflective Review

Collaborative learning is an umbrella term for a variety of educational approaches involving joint intellectual effort by students, or students and teachers together. Usually, students are working in groups of two or more, mutually searching for understanding, solutions, or meanings, or creating a product. Collaborative learning activities vary widely, but most center on students' exploration or application of the course material, not simply the teacher's presentation or explication of it.

Finally, it enables the students according to the requirements of the modern society by teaching them to work with their colleagues competently and successfully as explained. Collaborative learning is a form of constructivist teaching that takes the form of instructor-led group learning. In collaborative learning students are

encouraged to collaboratively solve problems through discourse instead of memorizing correct answers. The teacher plays a crucial role as a facilitator as well as a member of the knowledge community under study.

From the discussion above, it can be concluded that the Student Teams Achievement Division (STAD) is one method or approach in a simple and collaborative learning for teachers who are just beginning to use collaborative approach in the classroom, STAD also an effective method of collaborative learning. The main idea behind the model STAD is to motivate the students to encourage and help each other to master the skills presented by the teacher.

Chapter III

METHODS AND PROCEDURES

This chapter describes the methodology adopt in this research under following sub-headings. The sub-headings includes design of the research, population of the study, sample of the study, instruments of the study, data collection procedure, data analysis procedures.

Design of the Study

Research design is the frame work of the research. It is the systematic arrangement of the procedure or the plan which have been followed by the researchers. In this particular research researcher adopted an experimental research design. For this, researcher divided two groups. One was experimental group and the other was the control groups. Experimental group contained the students which had allowed learning by collaborative learning and the other control group was given opportunity to learn by traditional learning. In the schools the experimental group and control group were be selected randomly. Randomization assures statistical equivalence of two groups prior to introduction of the experimental treatment of the instructional strategy. Though researcher's researched quantitative nature in such way that researcher used some qualitative data for analyze. These data were done to reflect the activities happen in the grade room researcher have used descriptive approach to make such reflections.

This study based on pre-test, post test non-equivalent experimental group design under experimental paradigm as given below:

Experimental design

Table-1   Pre-test & Post test non-equivalent group design

Pre-test	Randomly Assign Group	Independent variable	Post-test	Dependent variable
T_1	Experimental	Collaborative learning approach	T_2	Mathematics achievement
T_1	control	Traditional learning approach	T_2	Mathematics achievement

Researcher considered students of grade nine studying mathematics in Bhaktapur district as the experimental design. Researcher had followed the following steps to do sampling.

- Researcher had selected the students of Gandhi Adarsha Secondary School Gothatar.
- Researcher had given the name of collaborative learning for students of section B and traditional learning for the students of section A through the coin toss method.

There were 40 students studying in grade nine out of them 10 girls and 10 boys in section B and 12 girls and 8 boys in section A. The following table summarizes this information.

Table-2   Students' Demography in the Selected School

Section A			Section B		
Boys	Girls	Total	Boys	Girls	Total
8	12	20	10	14	24

The total number of students, so as to make the sample unbiased and to control different variables that could positively affected on students achievement, some students were identified and excluded for the participation in the experiment.

Affecting Variable and Control Exercise in the Experiment

The main affecting variable and control exercise in the experiment as follows:

Teacher's variable:- Researcher himself to taught both experimental and control groups. They were taught for same duration of time and same unit, which controls certain extraneous variable such as teacher's qualification emotion and other variables.

Subject matter:- Same content had taught both experimental and control groups from the same curriculum, same textbook prescribed by government of Nepal.

Students:- Both groups were selected from class nine from the Gandhi Adarsha Secondary School in Bhaktapur. The numbers of students in experimental group were 20 in section B and the number of students of control group was 20.

Evaluation applied:- After the end of the experiment, the same text is given to the experimental and control group. The researcher himself also marks the test paper of the students by appendix C.

Length of experiment:- The researcher has divided equal time duration to teach both experimental and control groups. I had taught three weeks to both groups by collaborative learning approaches and traditional learning approaches.

Creating the Environment of Collaborative Learning

Creating the environment of collaborative learning are as follow:

- The whole class was divided in to four groups.
- Teacher gave the problems of this related chapter for the students.

- The role of teacher as a facilator, where the teachers planning and classroom practices were consistently to pitch at the growing edge of student's demonstrated competence.

- Student-students Interaction, teacher-students dialogue, more abstract and general ideas are privileged over experimental and concrete concepts, where as symmetry interaction with peers, students are more likely to employ everyday terms and examples and to tentatively try-out ideals.

Population and Sample for the Study

Research has selected the Gandhi Adarsha secondary school, Bhaktapur, Gothatar. In school, there are 40 students in class nine. Researcher has divided in to 40 students in two groups namely one is section A and other is section B from odd and even rolls number for the fulfillment of this purpose. I had chosen section A for control group and section B for experimental group. Pre-test has conducted to identify whether the group are comparable. After that experimental group are divided by four groups. Each group has containing five students.

Instrument of the Study

Development of tools is very important in order to collect the required data. For this research, the following instruments had developed to collect data in study.

Achievement Test (pre-test and post- test).

For this research researcher had used the tools namely the teaching plan and the achievement test. Achievement test consist of 39 questions, in which 22 were objectives, 12 were short questions and 5 were long questions. Researcher developed these questions according to the prescribed textbook of standard nine from optional mathematics according to the new curriculum. The test consists of 14 knowledge level, 18 skill level and 7 problem solving level questions based on chapter matrix.

Before the test did develop, researcher discussed with subject teacher of school and experts to minimize the complexity and language error of the items.

Reliability of Test

The reliability is the degree in which a test consistently measures whatever it measures. The more reliable a test is, the more confidently we can have that the scores obtained from the repeated administration of the test are essentially the same. Thus, reliability refers to the consistency of the results. Rational equivalence reliability was adopted to determine internal consistency by determining how each item on the test related to all other items and to the total test. The most common method of reliability is the split half method in which the test is divided into hales, the common way is odd even method. It is determined through the application of point Biserial correlation coefficient (rpbis), which is calculated by using the formula given In the appendix D. Applying point Biserial correlation coefficient (rpbis) the mean calculated value (correlation coefficient) of the reliability was found to be 0.76. It indicates that mathematical achievement test is reliable.

Validity of Test

According to Creswell (2003) 'validity refers to whether the questionnaire of survey measures what it intends to measure'. The researcher needs to identify threats to internal validity and external validity of research. Internal validity threats are experimental procedure, treatment or experience of the participants that threats researcher's ability to draw correct inferences from the data in the research. External validity threats arise when researchers draw incorrect inferences from the sample data to other person, other setting and past or future situations. To maintain validity, Researcher prepared specification chart. Apart from this, Researcher had also got the feedback from exports and thesis supervisor.

Data Collection Procedure

During the experiment, two different treatment patterns were applied. The researcher teaches himself both the experimental and control group during three weeks. Researcher had taken classes on both group, Experimental group in Gandhi Adarsha Secondary School in class nine from section B by using the collaborative learning and control group from section A in the same school by using the traditional learning from 2073-03-10 to 2073-03-26. The experimental group was taught matrix by collaborative learning according to the module given in Appendix F. During the class period to control other variables researcher had to do some job. Researcher taught the collaborative learning in the traditional learning in the first period so to maintain the tiredness of the student researcher started the classes by saying some jocks so that each student would be cataract to the lesson. In experimental research teacher's personality is also one of the factors so to maintain the personality researcher himself taught in both of the classes. Researcher spoke same types of words in both of the classes so that the verbal problem would not affect the achievement of the students.

At the end of the classes researcher had given same types of problem to solve at home and next day student of both groups submitted the work to check. Researcher created the friendly environment on both groups. To give the equal chance for a student in a group researcher allowed them to change their sheet every day in both of the groups. Any types question positive in the sense of topic or negative was respectfully accepted and the solutions of their problem were given. Group were formed maintaining the ethnicity maturity, sex, locality, knowledge ability in both of the groups so that it could be sure that achievement test score were not affected by any other independent variable other than learning method. During the post test period

researcher was announced the test schedule three days ahead in both of the group and the examination halls of both of the group were similar size. Researcher himself invigilated for both groups same question paper were given Appendix C though the time of test was different the duration of the time period was same. Researcher himself invigilated for both groups researcher had conducted an achievement test at the end of the class. The score obtained by the researcher had maintained reflective dairy as qualitative data.

Experimental process

To control the effect due to other variables such as personality, emotion and behavior of the teacher, both experimental and control group did teach by researcher himself. Control group taught by traditional learning but the experimental group taught by using collaborative learning method by preparing teaching module.

Researcher selected Student's Team Achievements Division (STAD) method to teach the experimental group because it is the simple of all other method. It is the good model for the new teacher who is going to follow collaborative learning. To use STAD, for the experimental group researcher made four teams. Researcher followed STAD'S major components (Grade presentation, Team study, Quizzes (test), individual improvement, Team recognition and play way learning.).

Class Presentation: Researcher had presented subject matter using teaching module. Researcher briefly reviewed the prerequisite skill or information. Researcher demonstrated concept and skill using teaching materials. After the presentation of the subject matter, researcher gave some problem and examples among the students and researcher asked some students randomly which made all students prepared them to answer. Finally, researcher gave feedback to the students.

Team Study: Beside the grade presentation, researcher gave two copies of work sheets to each team. Each member of the team encouraged to solve the question and to help the teammate to learn discussion softly.

Quizzes (test): To become sure for all the team members reading in the lesson researcher used to ask some questions. Students were not allowed to work in team at that time so that researcher hoped they never raised the hidden curriculum within their team study.

Individual Improvement Score: To determine individual improvement score, firstly base score was determined. There were total six quizzes out of them each student five quizzes scores were used to determine the base score. To determine the base score of the student, sum of quizzes' score was divided by 5.

Team Recognition: Finally, average score of improvement score of each team members were calculated i.e. sum of the individual improvement score of each team was divided by the total number of each team members.

After crossing above five steps, post test was administrated to experimental group.

Data Analysis Procedure

The data obtained from achievement test was analyzed by using mean, standard deviation and variance for both the group with their secured marks in the test, t-test at 0.05 level of significant to find whether the difference of mean is statistically significant by using the method pooled variance formula in the Appendix D between two groups. In addition, that approach used to analyze the data obtained from reflective diary of researcher under the headings, motivation of students, participation of students, regularity of students, interaction of students off task and on task behavior of students.

Chapter IV

DATA ANALYSIS AND INTERPRETATION

This chapter is divided into two parts first one is based on quantitative data and other is qualitative data. Researcher collected the achievement score and organized, tabulated and subjected to statistical test and interpreted. The marks obtained by the students are tabulated in Appendix G.

Comparison of achievement score of the students in experimental & control group in pre-test

The main objective of the study was to compare the achievement between two groups. Researcher calculated the statistical tool t-value to check whether the different is statistically significant or not in the experimental and control groups for the achievement score in pre-test. For this, researcher showed the statistical data are tabulated in table three.

Table 3

Comparison of experimental & control group achievement in pre-test

Group	Sample	Mean	Standard deviation	variance	Tabulated t-value	Calculated t-value	Remarks
Experi mental	20	3.1	2.12	4.53	1.96	-0.074	Null Hypothesis Accepted
Control	20	3.15	2.03	4.127			

Table three indicates that, the mean marks obtained by experimental and the control groups in pre-test were 3.1 and 3.15 respectively which were slightly different. The calculated t-value in the test is -0.074, whose absolute value is smaller than the critical or tabulated t-value 1.96 at 0.05 level of significance with degree of freedom 38 in two tailed tests. Therefore the null hypothesis is accepted, so there is no

significance difference between the mean score of the experimental and control groups on the pre test. This indicates that the two groups of same school on same environment are comparable.

Comparison of achievement score of the students in experimental & control group in post-test

The main objective of the study was to compare the achievement score between experimental and control groups of the students taught by using collaborative learning and traditional learning. For this, researcher takes group wise mean, standard deviation and variance were calculated with their marks obtained in the test for the verification of the hypothesis. There is no significant different between the achievement score of the students taught by collaborative learning and traditional learning in post-test. Also, researcher showed the statistical data are tabulated in table four.

Table 4

Comparison of experimental & control group achievement in post-test

Group	Sample	Mean	Standard deviation	variance	Tabulated t-value	Calculated t-value	Remarks
Experimental	20	22.1	5.24	27.49	1.96	4.669	Null Hypothesis Rejected
Control	20	14.2	5.45	29.78			

Table four indicates that, the mean marks obtained by experimental and the control group in post-test was 22.1 and 14.2 respectively. The different between experimental and control groups of mean is 7.9. The calculated t-value in the test is 4.669, which is greater than the critical or tabulated t-value 1.96 at 0.05 levels of

significance with degree of freedom 38 in two tail tests. Therefore the null hypothesis is rejected and hence there is no significance difference between the mean score of the experimental group & control group on the achievement of the students. i.e the alternative hypothesis, there is significance difference between the mean score of the experimental group and control group on the achievement of the students. Thus the difference of the means is found significant at 0.05 level of significant for two tails test. This indicates that the students in the collaborative learning were benefited in the achievement of matrix than the students in traditional learning. It means that collaborative learning is better than the traditional learning in matrix. In this ways researcher conclude that the quantitative data of collaborative learning is more practicable as compare to traditional learning.

During the period of data collection researcher spent 12 days with students and became a friend of them. They could ask to researcher the question without any hesitation so both of the group benefited on their learning. In control groups researcher used to give lecture to make their concept clear and researcher used to do some problems to make their concept clear. In experimental group in most of the classes researcher gave the materials to study and they used to read the materials to find the facts things and to make their foundation clear. In most of the classes researcher felt tired at the end of the class of control group but in experimental group most of the class time finished in group work and their presentation so researcher felt easy in collaborative learning.
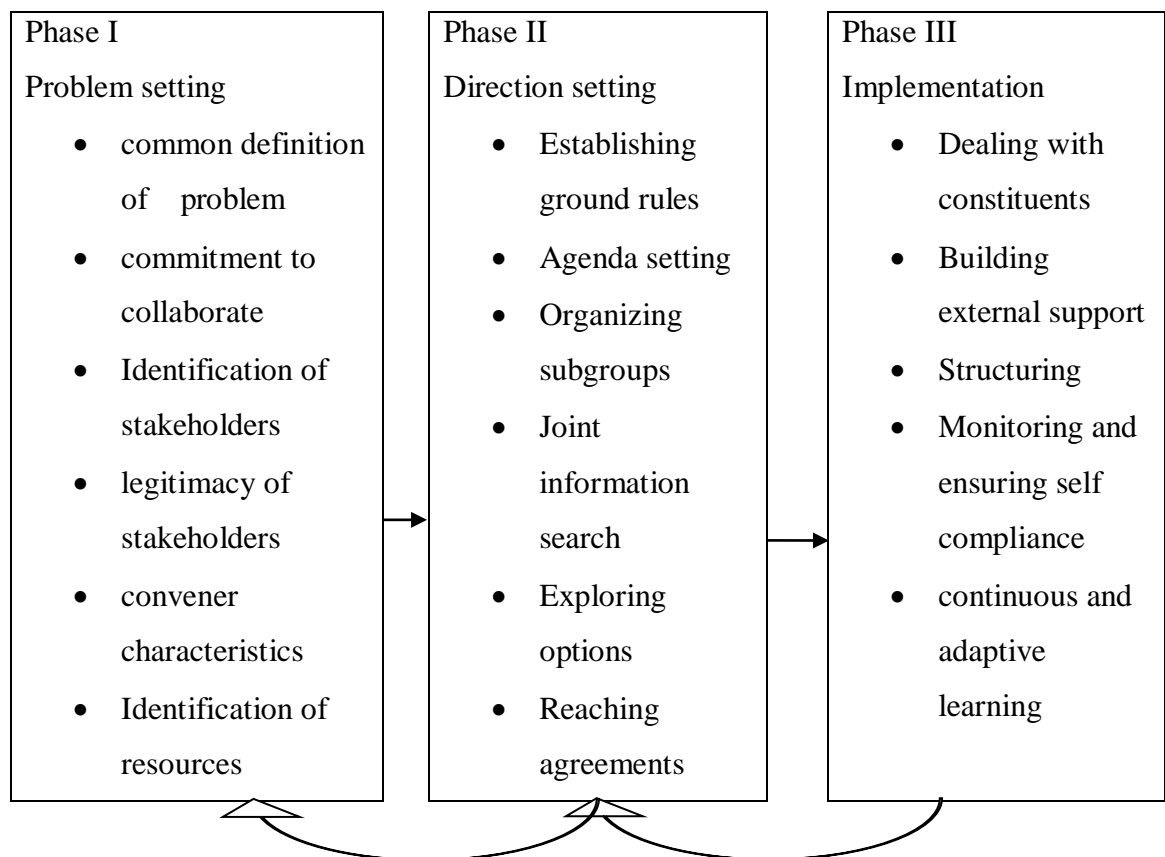
Reflective diary

Motivation: - Motivation is a phenomenon in which aspects of the immediate environment enhance motivation to learn particular things or behave in particular ways. Educators can do many things to create a classroom environment that motivates

students to learn and behave in ways that promote their long-term success. Motivation enhances cognitive processing. Motivation actually affects what and how information is processed because motivated students are more likely to pay attention and try to understand the material instead of simply going through the motion of learning in a superficial manner. Motivation was production of ability, desire & commitment. Motivation refers to the reasons for directing behavior towards a particular goal, engaging in a certain activity, or increasing energy and effort to achieve the goal.

Also collaborative learning helps teacher and students to learn mathematics easily and effectively and it provides different mathematical emerging issues through networking technology which also appreciate teacher and students to seek new ideas. Before, the collaborating learning students had no more idea about matrix. Moreover, they are not interested to learn matrix as mathematics.

By applying steps of collaborative learning;

Phase I Problem setting	Phase II Direction setting	Phase III Implementation
• common definition of problem • commitment to collaborate • Identification of stakeholders • legitimacy of stakeholders • convener characteristics • Identification of resources	• Establishing ground rules • Agenda setting • Organizing subgroups • Joint information search • Exploring options • Reaching agreements	• Dealing with constituents • Building external support • Structuring • Monitoring and ensuring self compliance • continuous and adaptive learning

They interested to learn about matrix as well as mathematics. Particularly, I use usual materials such as desk & bench, calendar, flash cards, paper, graph chart etc. to teach matrix in the class room. That makes well environment in class to teach matrix. After these activities student were motivated for learning to matrix. Motivations are usually performed by various means like counseling, providing opportunities, giving rewards and others. In recent years individual caring, collaborative learning, technological based teaching activities are increased slightly which is the opportunity of mathematics learning.

Punctuality: - Punctuality is the property of any person to be on exact time or complete any task within the given time. A person who always does his/her works on time is called as punctual. It enables a person to do right thing at right time without any excuse of delay in work. Students must be taught to reach their schools at right time. Punctuality is a powerful quality which can make a person successful and famous personality.

Punctuality is of great values to the students as it teachers them discipline also. Using this, students can be on right time everywhere such as in school, in lab in class, in library, at home, in examination hall, in project etc. They can perform better at both place home and school. It helps in removing laziness and negative attitudes of the students. A disciplined and punctual student always gets respect, recognition and social acceptance in the school and society. They appreciated a lot by the teachers and parents.

Generally, the ratio of students in the classroom was less cause of anxiety related to mathematics. When I apply this method in teaching then the ratio of student's presented increased in the classroom. In the duration of 12 days it was found

in classroom the punctuality of students were improved before applying collaborating method. Some reasons to improve the punctuality are as below:

- Group discussion.

- Use of materials in teaching.

- Game and puzzle.

- Brain storming activities.

In my 12 days teaching experience. I found that, in control group students think mathematics was just a boring but compulsory subject also they think mathematics learning is burden them. They are waiting the class off ring. Although in the experimental group can be regarded as collaborative effort of individuals working together to find the mutual positives and enhance that to achieve future possibilities. Therefore collaboration learning is smarter rather than harder. Students are appreciating to take class. So that students of experimental group are punctually.

Interaction:- The teacher student relationship is very important for children. Children spend approximately 5 to 7 hours a day with a teacher for almost 10 months. We ask ourselves what is considered a good teacher. All of us have gone through schooling, and if fortunate's had a favorite teacher. A positive relationship between the student and the teacher is difficult to establish, but can be found for both individuals at either end. The qualities for a positive relationship can vary to set a learning experience to learn. A teacher and students who have the qualities of good communications, respect in a classroom, and show interest in teaching from the point of view of the teacher and learning from a student will establish a positive relationship in the classroom.

The key is, teachers need to continuously monitor the student in order for him or her to be aware of any difficulties the students is having understanding the child's learning difficulties. Once the teacher becomes aware of the problems, he or she will

have more patience with the student, thus making the child feel secure of place confused when learning is taking place in the classroom. Collaborative learning is an interaction based approach which enables the enhanced engagement of teacher and student together through which they collaboratively seek and find the positives that help for learning and building knowledge. In the experimental group teacher are facilitate involves creating rich environments and activities for linking new information to prior knowledge, providing opportunities for collaborative work and problem solving them students are actively participation and self motivated for learning.

The role of teacher as a facilator, where the teacher planning and classroom practices were consistently to pitch at the grow edge of student's demonstrated competence. Student-students Interaction, teacher-students dialogue, more abstract and general ideas were privileged over experimental and concrete concepts, where as symmetry interaction with peers, students are more likely to employ everyday terms and examples and to tentatively try-out ideals.

They work together to achieve tasks and monitor their progress students can develop their abilities by sharing with other groups and gets feedback from them. Each also shares ideas with the whole class. So they can learn meaningfully concept of matrix by sharing ideas each other. Moreover, collaborative learning in mathematics teaching promotes interactions, among students themselves and between students and teacher. It also promotes and contributes for mathematical knowledge.

Homework:- Homework is defined as out-of-class tasks assigned to students as an extension or elaboration of classroom work. Homework is meant to be a positive experience and to encourage children to learn. Assignment should not be used as punishment. Teachers assign homework for many different reasons, and students may

not always endorse or even understand their teachers' goals. However, the fact that students don't always understand or agree with us doesn't give us the luxury of ignoring their views several factors argue against dismissing these complain. Teachers assign homework for many reasons. Homework can help children.

- review and practice what they've learned,

- get ready for the day's class,

- learn to use resources, such as libraries, reference materials and encyclopedias,

- Explore subjects more fully than time permits in the classroom.

Homework can also help children develop good habits and attitudes.

Researcher also involved and participate students in assign homework to improve their learning ability. Thus the cause of collaborative learning the participated of students in assign homework was increased, Near to data line of my research it seem that complete their homework fabulously.

Discussion

The analysis of the focus groups transcript suggest that the collaborative learning groups are effective at assisting students in processing and learning the course material. There are some factors, however, that hinder how efficiently this instructional strategy operates in the large enrollment course for mathematics. Clearly, the most important factor, apparent in four out of five themes, was poor attendance. The lack of attendance of students inhibits how well the collaborative learning groups work in numerous aspects: group formation, use of roles, and how effectively the groups aided in the learning processes of the participants to name a few. Collaborative class is more effective than normal. Moreover, using the group activities further supports students in gaining a deeper understanding of the subject material.

A substantial conflict occurs when students with two extreme types of motivation are placed of self-formed groups which produce varying group compositions, some of which do not work well together. It is clear that the way the self-formed collaborative groups are created has room for improvement and needs to be systematically explored in future studies.

The biggest problem with this scenario is that groups of dependable students would form as well as groups composed entirely of students who are constantly absent. The system of collaborative group learning will then benefit the students who need the least amount of help to begin with, while leaving the students who really need to be attended to by the wayside.

Another issue still to be addressed is the exact necessity of assigned roles within the collaborative groups. According to the data obtained in the focus groups, the answer is no. The vast majority ignore the roles completely with the exception of the recorder and perhaps the leader. The argument that students provided was that the roles were unnecessary to complete the tasks in a timely fashion.

Overall when I facilate the both group experimental and control group I concluded that experimental group are enthusiasm for to know about new thing and when they have any problem they did not hesitate to asked their teacher and friends. On the other hand control groups students control groups students not concentrated in teaching learning activities. No values are given to the knowledge, beliefs and attitudes of students and to what students think and belief. Students are rarely motivated and allowed to follow alternative ideas and approaches. It was found that students' performance in mathematics and attitudes towards mathematics were affected by exposure to the collaborative learning. So that experimental group is more effective than the control group.

Chapter V

SUMMARY, FINDING, CONCLUSION AND RECOMMENDATIONS

In this chapter researcher is going to deal about the summary, finding, conclusion, recommendations and suggestions for further study. These are presented as follows:-

Summary

Researcher did the experimental research which goes in mixed method i.e quantitative and qualitative. The main objective of this study was to find the effectiveness of collaborative learning in teaching matrix in grade nine. In order to conduct the experiment, researcher developed a teaching module and taught the student of experimental group by collaborative learning and control group by tradition learning for 12 days. At the end of the experiment, researcher performed a standardized achievement test. This test was administered on both groups. The scores obtained by the students in the test were analyzed using mean, variance, standard deviation and t-test. Initially researcher took a pre-test and the so formed result indicated that there is no significance difference between the achievement between the control and experimental group. But in post-test the result indicated that there significance difference between the control and experimental group. I found that students behavior slightly change through teaching collaborative learning approach.

Finding

On the basis of the analysis of the scores, the findings of the study are as follows: The basis of the analysis and interpretation of the data obtained from the achievement test was found that the average score of the students of experimental group is higher than the average score of the students of control group is higher than the average score of the students of control group. Statistically the mean difference

was significant. Thus it was concluded that the collaborative learning was effective method in teaching matrix in class nine.

Also this study investigated the relationship between students' motivation, punctuality, interaction & homework and their participation in collaborative learning during three weeks in class nine at matrix. By applying steps of collaborative learning it provided more idea about matrix then the students motivated to learn about matrix as well as mathematics. When researcher applied this method in teaching then the ratio of students' punctuality increased in the classroom. It caused for collaborative work and problem solving with active interaction between student-student and teacher-students, where teacher play role of facilator. As a result, collaborative learning caused the active participation of all of the students in their assign homework. Thus it was concluded that the collaborative learning was effective method in teaching matrix in class nine.

Conclusion

In this study the researcher found that the mean achievement score of experimental group is higher than control group. Also statistically it is significant. It is concluded that collaborative learning is more effective than traditional learning in teaching matrix at class nine. Collaborative learning better motives students to learn, helps students to understand and perform better in achievement test over traditional learning in teaching 'matrix' at grade IX.

Recommendation

On the basis of findings of the study, some measures have been recommended for the teaching learning situation at class nine as given below:-

- Collaborative learning is suggested to adopt in teaching "matrix" at class nine.

- The mathematics teacher should be encouraged to use collaborative learning in teaching 'Matrix' at class nine.

- The teacher training institutes should focus their attention on collaborative learning.

- Curriculum designer, textbook writer should emphasize on collaborative learning.

Suggestions for Further Study

The following suggestions are made for further study:

- Study on designing different teaching and learning modules should be carried out, so that these modules can be used on classroom teaching.

- Further study should be done on different districts of Nepal, using different research designs, different samples in different topics and in different levels.

- Study on the opinions and attitudes of teachers and pupils towards the use of collaborations learning should be carried out. Different collaboration learning strategies (i.e. Learning Together (LT), Academic controversy (AC), Team-Games-Tournaments (TGT), jigsaw etc. should be carried out in all branches of school mathematics.

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APPENDICES

Appendix A Time schedule and lesson plan for experimental group: specification grids

Topics	Time	Knowledge		Skill			Problem solving			
		objectives	short	objectives	short	long	objectives	short	long	total
matrix, order and notation	2 periods	4(4)		3(3)	2(4)	1(4)				10(5)
some special types of matrices	1 periods	3(3)		1(1)						4(4)
equal matrices	1 periods	1(1)		1(1)	1(2)		1(1)		1(4)	5(9)
addition and subtraction of matrices	2 periods	1(1)	1(2)	2(2)	2(4)					6(9)
multiplication of matrices by a scalar	1 periods							1(2)		1(2)
algebraic properties of matrices	2 periods	1(1)		2(2)	1(2)			1(2)		5(5)
solving matrix equation	1 periods							1(2)		1(2)
transpose of matrices	1 periods	2(2)	1(2)							3(4)
properties of transpose	1 periods				1(2)	1(4)				2(6)
total member of questions	12 periods	12(12)	2(4)	9(9)	7(14)	2(8)	1(1)	3(6)		37(46)

Appendix B number of question of different level

question no.	knowledge	skill	problem solving
1		✘	
2		✓	
3	✘		
4	✘		
5	✘		
6	✓		
7		✘	
8			✓
9	✘		
10	✓		
11	✘		
12	✘		
13		✘	
14	✓		
15	✓		
16		✓	
17	✘		
18		✘	
19		✓	
20	✘		
21		✓	
22		✓	
23		✓	
24		✓	
25		✘	
26			✘
27		✘	
28	✓		
29			✘
30	✓		
31		✓	
32			✘
33		✘	
34		✘	
35		✓	
36			✓
37		✓	
38			✘
39			✓
total	14	18	7

Appendix B represents the total number of item selected in item analysis, where the (✓) marked

questions were selected after item analysis for the achievement test and (✘) marked were deselected

after the item analysis.

Appendix C Items Rejected After Analysis

Put tick mark (✓) for the correct alternatives

1. Which of the following is not a matrix?

   (a) $\begin{bmatrix} 2 & 3 \\ 1 & \end{bmatrix}$ b) [1 2]   c) $\begin{bmatrix} 3 \\ 4 \end{bmatrix}$ d) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

2. What is the value of a_{21} in the matrix $A = \begin{bmatrix} 2 & 4 & 5 \\ -2 & 3 & -4 \end{bmatrix}$? Where a_{ij} is element of

   i^{th} rows and j^{th} column in the matrix A.

   (a) 4   b) -2   c) 5   d) -4

3. What is the value of 'a' if $\begin{bmatrix} a & b \\ c & d \end{bmatrix} = \begin{bmatrix} 3 & x \\ 4 & 2 \end{bmatrix}$?

   a) 2   b) 4   c) 1   d) 3

4. For a matrix $\begin{bmatrix} 1 & 6 \\ 2 & 4 \end{bmatrix}$ $a_{ij}=6$. What is the sum of i and j?

   a) 2   b) 3   c) 4   d) 1

5. Which is the identity matrix?

   a) $\begin{bmatrix} 2 & 3 \\ 1 & \end{bmatrix}$ b) $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$ c) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ d) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

6. What type of matrix is $\begin{bmatrix} 2 & 0 \\ 0 & 2 \end{bmatrix}$ it?

   a) scalar   b) diagonal   c) square   d) all of these.

7. Which one of the following is null matrix?

   a) A= $\begin{bmatrix} 0 & 0 \\ 2 & 1 \end{bmatrix}$ b) B=$\begin{bmatrix} 2 & 3 \\ 1 & \end{bmatrix}$ c) C=$\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$ d) D=$\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$

8. Which is an main language of matrix?

   a) row   b) column   c) both a and b d) none of the above

9. Which of the following two matrices are compatible under addition?

   a) $\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 7 \end{bmatrix}$ and $\begin{bmatrix} 2 & 4 & 3 \\ 4 & 6 & 0 \end{bmatrix}$ b) $\begin{bmatrix} 1 & 3 \\ 4 & 5 \end{bmatrix}$ and $\begin{bmatrix} 2 \\ -9 \end{bmatrix}$

   c) $\begin{bmatrix} 1 & 2 \\ 4 & 5 \end{bmatrix}$ and [3 4]   d) $\begin{bmatrix} 2 & 5 \\ 6 & 7 \end{bmatrix}$ and $\begin{bmatrix} 1 & 2 & 3 \\ -5 & 6 & 8 \\ 9 & 0 & 0 \end{bmatrix}$

10. Which is the example of square matrix?

a) $\begin{bmatrix} 0 & 0 \\ 2 & 1 \end{bmatrix}$ b)[2   3]   c) $\begin{bmatrix} 0 \\ 1 \end{bmatrix}$ d) $\begin{bmatrix} 0 & 0 \\ 3 & 2 \\ 2 & 1 \end{bmatrix}$

11. Which is the example of unit matrix?

a) $\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}$ b) $\begin{bmatrix} 0 & 0 \\ 2 & 1 \end{bmatrix}$ c) $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$ d) $\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$

12. Transpose of which of the following matrices is itself?

a) $\begin{bmatrix} 3 & 4 \\ 0 & 1 \end{bmatrix}$ b) $\begin{bmatrix} 4 & 2 \\ 3 & 1 \end{bmatrix}$ c) $\begin{bmatrix} 3 & 2 \\ 2 & 0 \end{bmatrix}$ d) $\begin{bmatrix} 5 & 3 \\ 2 & 6 \end{bmatrix}$

13. The numbers in a matrix are called ………

    a) its columns   b)its rows   c)its elements   d)none of the above

14. A= $\begin{bmatrix} 3 & 2 & 4 \\ 0 & 5 & 1 \end{bmatrix}$ matrix is a

    a) 2×3 matrix   b) 3×1 matrix   c) 3×3 matrix   d)3×2 matrix

15. A matrix having m rows and n columns is called………

    a) an m×n matrix   b)order of m×n matrix   c)dimension of m×n matrix   d) all

    of the above

16. Which matrix is a scalar matrix as k=2 ?

a) $\begin{bmatrix} 3 & 4 \\ 0 & 1 \end{bmatrix}$ b) $\begin{bmatrix} 6 & 4 \\ 2 & 8 \end{bmatrix}$ c) $\begin{bmatrix} 3 & 0 \\ 0 & 1 \end{bmatrix}$ d) $\begin{bmatrix} 0 & 2 \\ 1 & 1 \end{bmatrix}$

17. Which is the addition property of matrix?

    a) AB=BA   b) A/B=B/A   c) A-B=B-A   d) A+B=B+A

18. Transpose of which of the following matrices is itself?

a) $\begin{bmatrix} 3 & 4 \\ 0 & 1 \end{bmatrix}$ b) $\begin{bmatrix} 3 & 2 \\ 2 & 0 \end{bmatrix}$ c) $\begin{bmatrix} 4 & 2 \\ 3 & 1 \end{bmatrix}$ d) $\begin{bmatrix} 5 & 3 \\ 2 & 6 \end{bmatrix}$

19. For the matrix equation $\begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} 3 \\ 2 \end{bmatrix} = \begin{bmatrix} 4 \\ 5 \end{bmatrix}$ the values of x and y respectively

    a) 1&3   b) 2&3   c) 3&1   d) 3&2

20. For a matrix $\begin{bmatrix} 1 & 6 \\ 2 & 4 \end{bmatrix}$ $a_{ij}=6$. What is the sum of i and j?

    a) 2   b) 3   c) 4   d) 1

21. Find the adjoint of the following matrix?

$$A=\begin{bmatrix} 2 & 1 \\ 4 & -1 \end{bmatrix}$$

(a) $\begin{bmatrix} 1 & 6 \\ 2 & 4 \end{bmatrix}$ b) $\begin{bmatrix} -1 & 3 \\ 2 & 4 \end{bmatrix}$ c) $\begin{bmatrix} 1 & -2 \\ 3 & 4 \end{bmatrix}$ d) $\begin{bmatrix} -1 & -1 \\ -4 & 2 \end{bmatrix}$

22. Find the cofactor of 2 of the following matrix?

$$A=\begin{bmatrix} 2 & 1 \\ 4 & -1 \end{bmatrix}$$

(a) -1   b) 2   c) -4   d) 4

Short question

23. Write any two example of square matrix?

24. If A= $\begin{bmatrix} 5 & 2 \\ 2 & 1 \end{bmatrix}$ and B= $\begin{bmatrix} 3 & 0 \\ 1 & 1 \end{bmatrix}$ find the matrix 2A-3B.

25. Write down one example of 2×3 matrix.

26. If A+B= $\begin{bmatrix} 4 \\ 1 \end{bmatrix}$ and A-B= $\begin{bmatrix} 2 \\ 3 \end{bmatrix}$ find the matrix A and B.

27. Find the inverse of the matrix A= $\begin{bmatrix} 3 & 2 \\ 1 & 4 \end{bmatrix}$.

28. If A= $\begin{bmatrix} 1 & 2 \\ 5 & 6 \end{bmatrix}$ and B= $\begin{bmatrix} 2 & 3 \\ 5 & 1 \end{bmatrix}$ verify that A+B=B+A.

29. Find the sum of the matrices $\begin{bmatrix} 3 & -2 \\ 1 & 5 \end{bmatrix}+\begin{bmatrix} 3 & 5 \\ -8 & 2 \end{bmatrix}$.

30. Write down the two properties of matrix?

31. Simplify $\begin{bmatrix} 2 & 1 \\ 2 & -1 \end{bmatrix}-\begin{bmatrix} 4 & 0 \\ 1 & 1 \end{bmatrix}+\begin{bmatrix} 6 & -3 \\ 2 & 1 \end{bmatrix}$.

32. If A= $\begin{bmatrix} 2 & 3 \\ 2 & 4 \end{bmatrix}$ and B= $\begin{bmatrix} 3 & 1 \\ 2 & 1 \end{bmatrix}$ and k=2 verify that k(A+B).

33. If A= $\begin{bmatrix} 3 & 2 \\ 2 & -1 \end{bmatrix}$ and B= $\begin{bmatrix} 1 & -2 \\ 3 & 0 \end{bmatrix}$, find AB.

34. Multiply $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}\begin{bmatrix} 5 \\ 1 \end{bmatrix}$.

Long questions

35. Solve X+3Y= $\begin{bmatrix} 2 & 5 \\ 4 & 1 \end{bmatrix}$, 3X-2Y= $\begin{bmatrix} -2 & 3 \\ -4 & 1 \end{bmatrix}$

36. Find the values of X,Y,a and b if $\begin{bmatrix} x+y & a+b \\ a-b & 2x-3y \end{bmatrix} = \begin{bmatrix} 5 & -1 \\ 3 & -5 \end{bmatrix}$

37. If A= $\begin{bmatrix} 4 & 1 \\ -1 & 2 \end{bmatrix}$, show that $6A-A^2=9I$, where I is an identity matrix of order

2×2.

38. Solve: 2x-3y=5 and 4x+y=3 by using matrix method.

39. Let A= $\begin{bmatrix} 1 & 5 \\ 2 & -2 \\ -3 & 3 \end{bmatrix}$, B= $\begin{bmatrix} 2 & 0 \\ 1 & 1 \\ -3 & 3 \end{bmatrix}$ verify that $(A+B)^T=A^T+B^T$.

Appendix D formula used to analyze data in study

i.   Mean $(\bar{X})=\frac{\sum X}{N}$

ii.   Variance $(S^2)=\frac{\sum d^2}{N}-\left\{\frac{\sum d}{N}\right\}^2$ where d= X-A$\left\{\frac{\sum d}{N}\right\}^2$

iii.   Variance $(S^2)=\frac{\sum(X-\bar{X})^2}{N}$

iv.   Calculated value of t=$\frac{\bar{X}_1-\bar{X}_2}{\sqrt{S_p^2\left\{\frac{1}{N1}+\frac{1}{N2}\right\}}}$ Tabulated value of t=t_a , (n_1+n_2-2)

$S_p^2=\frac{\sum X_1^2+\sum X_2^2}{(N_1-1)(N_2-1)}=\frac{(N_1-1)\sigma_1^2+(N_2-1)\sigma_2^2}{N_1+N_2-2}$

Where $X_! =X_! - \bar{X1}$ and $X_2 =X_2 - \bar{X2}$

v.   F=$\frac{S_2^2}{S_1^2}$ where $S_2^2 > S_1^2$ Tabulated F=F_a, $(n_1-1)(n_2-1)$

where $S_1^2=\frac{\sum(X_!-\bar{X1})^2}{N_1-1}$, $S_2^2=\frac{\sum(X_2-\bar{X2})^2}{N_2-1}$

Point Biserial correlation coefficient: rpbis = $\frac{Y_1-Y}{S_y}\sqrt{\frac{p_x}{1-p_x}}$

where Y = mean achievement score of total students

Y_1 = mean achievement score of the students who gave the true answers on each question

S_y = standard deviation of total students

P_x = ration of students giving true answer in each questions.

Appendix E Lesson Modules   Date: 2073/2/27

Subject:- optional mathematics

Time duration:- 12 period of 45 minutes each

Unit:- Matrices

Grade:- IX

Theme/Concept

Meaning and concept of contextualized teaching method in the area of matrix.

Long –Term Objectives

- ➢ To develop the positive attitude of teachers towards their students and
    mathematics.
- ➢ To provide foundation for the students in matrix.
- ➢ To provide the sufficient background in matrix for the students.
- ➢ To develop the skill of representing matrix, finding sum and differences of
    matrices.

Short-Term Objectives

- ➢ To discuss the meaning of matrix
- ➢ To demonstrate the concept of matrix as far as practically.
- ➢ To contextualize the meaning of matrix in their local context.
- ➢ To generalize the problems of matrices on the corresponding field.
- ➢ To make able to notation of matrix, its elements in their corresponding field.
- ➢ To make familiar on Matrix notation and order.
- ➢ To investigate the algebraic properties of matrix addition.
- ➢ To find the sum, difference, multiplication of a matrix by a scalar and transpose
    of matrix.

Materials

Flash cards, pencils, paper, scale, compass, text book, chalk, graph chart, calendar

Major Activities

- ➢ Brain storming activities

- ➢ Grouping activities

- ➢ Bridging activities

- ➢ Questioning activities

- ➢ Engaging activities

- ➢ Reflection activities

Activities in Details: First Day's Activities

Brainstorming activities   Date: 2073/3/12

I will inter the class with smiley face and call one of the interested students to count the number of the students in the class and classify them in two way table with heading boys, girls, wearing spectacles. Probably they will prepare the table given below.

	Numbers of boys	Number of girls
Wearing spectacles	4	3
Not wearing spectacles	8	5

I will ask some questions related to this table like how many students all together in your class? How many wear spectacles? What does the first horizontal line represent? What does the second vertical line represent? What does the first vertical line represent? How many boys do wear spectacles? How many girls do wear spectacles?

Grouping:- I will divide the students in to four groups based on their abilities in mathematics to form heterogeneous groups. They will sit together group- wise A,B,C&D each group contains 5 students. These groups help me to make the class effective and the collaborative learning strategies will be fulfill.

Bridging:- The topic matrix is totally new for class IX. I will try to bridge the students from above example I will show some arrangement of number in calendar asked some

questions like how many Saturday are there in a month? Where do you find these Saturdays in the calendar? In brainstorming activities.

Questioning:- I will give chance to ask question for each group among themselves so that will be interdependent on their group work and they can ask the question to me to clarify their matter.

Engaging:- I will give the topics matrix, its order and notation to all groups to discuss and to find the more convenient method to instruct and present. They will get chance to read text book to get the idea about notations, rows, columns and order of matrix. I will provide them necessary and available teaching material for the contextual understanding. After the discussion of 15 minutes, group A will present to answer the question what is matrix? Group B present on how matrices and its member are symbolized? Group C will present on row of matrices. Group D will present in column on matrices. Each group will present on the basis of their finding on text book. I will help them if necessary.

Reflection:- Students will reflect the class activities in a short essay so that they will get the strong foundation for conceptual understanding. They will reflect their understanding in homework also.

Assessment:- I divide the time of 45 minutes for the above activities.

Second day activities: problem solving in group   Date: 2073/3/13

Connecting the last day activities I will repeat the terms and terminology which was mention in first class. I will divide the students in 4 groups containing 5 students each and distribute work sheet to do some problems and to make their foundation. I will divide the work as follows question no 1,2&3 of the following problems for one group. Question no 4 and 5 other group 6 and 7 for other group and 8 for other group. I will give them question to the group by lottery method.

Worksheet 3 students of grade IX secured the following marks in three subject English, nepali and math.

Name of students	English	Math's	Nepali
Rabin	60	72	68
Muskan	80	93	71
Ranjeet	65	88	55

    a.   Write the information in matrix form.

    b.   How many elements are there in the matrix? What is its order?

    c.   If the matrix is represented by M then how can its order be represented?

1. Write the order of the following matrices.

    a) $\begin{bmatrix} a & b \\ c & s \end{bmatrix}$ b) $\begin{bmatrix} 1 \\ 2 \end{bmatrix}$ c) $[3 \quad 5]$ d) $\begin{bmatrix} 0 & 0 \\ 0 & 0 \end{bmatrix}$

2. What is the order of the matrix $\begin{bmatrix} 1 & 3 & 5 \\ 2 & 2 & 6 \end{bmatrix}$?

3. Find the value of a_{21}, a_{22}, a_{23}, a_{11} and a_{13} in the matrix $\begin{bmatrix} -1 & 4 & -3 \\ -2 & 3 & 4 \end{bmatrix}$

4. For a matrix $\begin{bmatrix} 2 & 7 \\ 1 & 5 \end{bmatrix}$ $a_{ij}=6$ then what is the sum of i and j?

5. If a matrix has the following number of elements then find the possible orders of the matrices.

    a) 8   b) 5   c)9   d) 2

6. If A=$\begin{bmatrix} 1 & 0 & 5 \\ 4 & 2 & 1 \\ 5 & 1 & 0 \end{bmatrix}$ find all possible answers to each of the followings

    a) a_{23} =?   b) $a_{ij}=1$ then i=? j=?   c) if $a_{i2} = 1$ then i=?   d) $a_{3j}=$?if $1 \leq j \leq 3$

7. Construct the following matrices

    a) A 2×2 matrix A, whose elements $a_{ij} = 3i-2j$

    b) A 3×2 matrix B, whose elements $b_{ij}= 3i-10j$

    c) A 5×1 matrix A, whose elements $a_{ij}= 4ij$

They discuss and solve these problems in group. I will help to omit their difficulty. After

the compulsion of their group work each student within the group will get roll no.

1,2,3,4,5 and they will rearrange like roll 1 of all groups at a same place and roll 2 of all group at another place and soon. After this rearrangement each member of the new group will teach his knowing to his group member.

Day Three: Discussion within the Group and presentation Date: 2073/3/14

Some special types of matrices (rectangular matrix, row matrix, column matrix, square matrix, null matrix, diagonal matrix, identity matrix, triangular matrix)

Major activities

Brain storming activities:- To storm the brain of students towards the lesson I will ask the question about the types of vehicles like how many types of vehicles do you see and what are they?

Grouping activities:- I will divide the students in five groups A,B,C&D each group contains 5 students.

Bridging activities:- I will summarizes the yesterday's class within 3 minutes and ask them to differentiate between the following matrices a. A and B b. A and C   c. A and D d. B and D for each group A,B,C& D respectively where,

$A=\begin{bmatrix} 2 & 3 & 1 \\ 5 & 6 & 2 \\ 3 & 4 & 1 \end{bmatrix}$, $B=\begin{bmatrix} 4 & o \\ 0 & 2 \end{bmatrix}$, $C=\begin{bmatrix} 4 & 2 & 1 \\ -1 & -2 & 2 \end{bmatrix}$, $D=\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}$ they can present their findings towards the class.

Question activities:- I will ask the following question to the students.

a.   How many rows and columns in the matrices A,B,C&D?

b.   What are their geometrical shapes?

I will let them to ask questions.

Engaging activities:- I will pest chart writing different types of matrices with their definition and examples and let them time to discuss about the different types of matrices and ask to prepare similar chart paper to present by kipping different examples of matrices. To save the time and make the class more effective I will give the topic rectangular matrix and row matrix for group A, column matrix and square matrix for

group B, null matrix and diagonal matrix for group C, scalar matrix and identity matrix for group D they will take the concept by reading the chart paper pasted in front of the class and I also will be there to help them. I will give 15 minutes time to discuss and to prepare chart paper. After preparing the chart each group will get 3 minutes time to present their work towards the class.

Reflection activities:- They will reflect the class activities by doing the following homework. Study the given matrices and answer the following questions with reasons

$$A=\begin{bmatrix} 4 & 2 & 1 \\ -1 & 3 & 2 \\ -7 & 6 & -2 \end{bmatrix}, \quad B=\begin{bmatrix} 4 & 1 \\ -1 & 2 \end{bmatrix}, \quad C=\begin{bmatrix} 1 & 4 & 1 \\ 3 & -1 & 2 \end{bmatrix}, \quad D=\begin{bmatrix} 0 \\ 0 \\ 0 \end{bmatrix}, \quad E=\begin{bmatrix} 1 & 1 \\ 1 & 1 \end{bmatrix}, \quad F=\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix},$$

$$G=\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}, \quad H=\begin{bmatrix} 0 & -1 \\ -1 & 0 \end{bmatrix} \quad I=\begin{bmatrix} 0 \\ 5 \end{bmatrix}$$

➢ Which of the above matrices are rectangular matrices?

➢ Which of the above matrices are square matrices?

➢ Which of the above matrices are diagonal matrices?

➢ Which of the above matrices are scalar matrices?

➢ Which of the above matrices are null matrices?

➢ Which of the above matrices are identity matrices?

➢ Which of the above matrices are triangular matrices?

➢ Which of the above matrices are column matrices?

Four day activities (quiz method): equal matrices   Date: 2073/3/15

Brain storming activities:- While interring the class, I will collect the last day homework and ask the question like who has more interest in quiz?

Grouping activities

As usual I will divide the students in four groups.

Bridging activities:- I will ask the following questions to bridge students towards the lesson equal matrices.

   a.   What do you mean by equality of two objects?

b. Mr Prabesh and Miss Anu secured the following marks in 4 major subjects whose performance is better.

Name of the students Prabesh poudel

subjects	Full marks	pass marks	marks obtained
Nepali	100	40	65
English	80	32	66
Math	100	40	88
Science	75	30	59

Name of students Uma Dhakal

subjects	Full marks	pass marks	marks obtained
Nepali	100	40	71
English	80	32	59
Math	100	40	87
Science	75	30	60

a. Write both the table in matrix form calling them A and B

b. What is the relation of these matrices?

Questioning activities:- It will fulfill by the bridging activities. They can ask the related question within the classes.

Engaging activities:- I will give a short lecture about the equality of matrices and its applications within 10 minutes and then I will ask to solve the following problems in groups wise. To follow quiz method of learning, first I will ask question no 1 to group A if they will give the correct answer I will award 5 marks if they will fail to give correct answer then I will give the chance for group B to answer the question, similarly for C&D awarding marks 3 for each group for the correct answer of the pass question. If none of

the group will give the correct answer them I will give the correct answer with reason to make their foundation strong. Similarly I will ask question no 2 for group B, they will solve the problems collaboratively so that each student will able to know the concept of equality of the matrices.

1. Which of the following matrices are equal?

   $A = \begin{bmatrix} 3 & 4 \\ 5 & 2 \end{bmatrix}$, $B = \begin{bmatrix} 3 & 5 \\ 4 & 2 \end{bmatrix}$, $C = \begin{bmatrix} 3 & 4 \\ 5 & 2 \end{bmatrix}$, $D = \begin{bmatrix} 4 & 5 \\ 2 & 3 \end{bmatrix}$

2. If $\begin{bmatrix} a & 0 \\ c & d \end{bmatrix} = \begin{bmatrix} 4 & x \\ 2 & 3 \end{bmatrix}$ then find the values of a, c, d and x.

3. If $\begin{bmatrix} 4x + 2 & 5 \\ y & 3 \end{bmatrix} = \begin{bmatrix} 0 & z \\ 2 + x & 3 \end{bmatrix}$ then find the value of 'y'.

4. Find the values of x, y, a and b if $\begin{bmatrix} 2x + y & a - b \\ a + b & x - 2y \end{bmatrix} = \begin{bmatrix} 4 & -1 \\ 2 & -3 \end{bmatrix}$

5. Find the values of a, b, c and d if $\begin{bmatrix} a & 5 \\ b & 3 \end{bmatrix} = \begin{bmatrix} 0 & c \\ 2 & c + 2d \end{bmatrix}$

6. Find the value of x and y: $\begin{bmatrix} x + y \\ x - y \end{bmatrix} = \begin{bmatrix} 5 \\ 3 \end{bmatrix}$

Fifth day activities (contextual application): addition and subtraction of matrices

Date: 2073/3/16

To teach about the addition and subtractions of the matrices I will do the following activities. I will make a chart writing the following information A man has two telephone sets matrix A summaries the total number of telephone calls for one week. Row 1 represents trunk calls, row 2 represents local calls, column 2 represents the first telephone set and the column 1 represents the second telephone set. Similarly the matrix B represents the telephone calls for the second week.

Telephone calls for the first week are as follows

	Set II	Set I
Trunk calls	10	12
Local calls	200	198

Telephone calls for the second week are as follows

	Set II	Set I
Trunks calls	15	9
Local calls	200	250

Therefore A= $\begin{bmatrix} 10 & 12 \\ 200 & 198 \end{bmatrix}$ and B= $\begin{bmatrix} 15 & 9 \\ 200 & 250 \end{bmatrix}$

How many local and trunk calls were phoned in each set during the two weeks period?

To find the answer we have to add the corresponding elements of the two matrices follow.

A+B = $\begin{bmatrix} 10 & 12 \\ 200 & 198 \end{bmatrix} + \begin{bmatrix} 15 & 9 \\ 200 & 250 \end{bmatrix} = \begin{bmatrix} 25 & 21 \\ 420 & 448 \end{bmatrix}$

I hope the above example will be sufficient to give concept on addition. To introduce subtraction I will raise issue of News paper available and sold in a particular day in two shops in the following matrices matrix A represent the news paper available in the shop B represents the sold item and C represents the remaining newspaper at the end of that day.

	Shop I	Shop II			Shop I	Shop II
A = Kantipur	35	60	B = Kantipur		35	60
Rising Nepal	26	57	Rising Nepal		26	57

Write the above information in matrix form A and B find the matrix C as mention above. This example will help the students be familiar in the topic subtraction. I will ask the students to make some matrices which are compatible under addition and subtraction and add and subtract them.

Six day activity: problem solving   Date: 2073/3/17

It will be continuous from fifth day activities on that class I will make the students engage in solving the following problem they solve these problems in groups they could take help with me.

1. Find the sum of the following matrices

a) $\begin{bmatrix} 5 \\ 3 \end{bmatrix} + \begin{bmatrix} 4 \\ -2 \end{bmatrix}$ b) $\begin{bmatrix} 14 & 5 & 3 & 9 \\ -2 & 5 & 7 & 3 \end{bmatrix} + \begin{bmatrix} -5 & 8 & 3 & 0 \\ -2 & 5 & -7 & 3 \end{bmatrix}$

c) $\begin{bmatrix} 12 & -6 \\ 1 & 4 \end{bmatrix} + \begin{bmatrix} 1 & 6 \\ 2 & 4 \end{bmatrix} + \begin{bmatrix} 1 & 6 \\ 2 & -4 \end{bmatrix}$

2. Find the difference of the following matrices.

a) $\begin{bmatrix} 8 \\ 3 \end{bmatrix} - \begin{bmatrix} 4 \\ -2 \end{bmatrix}$

b) $\begin{bmatrix} 11 & 5 & 2 & 9 \\ -2 & 5 & 7 & 3 \end{bmatrix} - \begin{bmatrix} -5 & 8 & 3 & 0 \\ -2 & 4 & -7 & 3 \end{bmatrix}$

c) $\begin{bmatrix} 12 & -6 \\ 1 & 4 \end{bmatrix} - \begin{bmatrix} 1 & 6 \\ 2 & 4 \end{bmatrix} - \begin{bmatrix} -1 & 6 \\ 2 & -4 \end{bmatrix}$

3. a) Find the values of x, y, z and t in the given equation

$$\begin{bmatrix} 2x & y \\ 1 & -4 \end{bmatrix} + \begin{bmatrix} 1 & 6 \\ 2 & 4z \end{bmatrix} = \begin{bmatrix} 1 & -2y \\ t & -4 \end{bmatrix}$$

b) Solve the matrix equation $\begin{bmatrix} x \\ y \end{bmatrix} + \begin{bmatrix} 6 \\ 4 \end{bmatrix} = \begin{bmatrix} -1 \\ 2 \end{bmatrix}$

Seventh day activities: Applicable examples   Date: 2073/3/19

Multiplication of a matrix by a scalar

To teach the multiplication of a matrix by a constant number I will distribute the work

sheet to find the total purchases price and the delivery cost (per quintal) separately for

two brands of rice (Basmati and Mansuli) to three different retailers by a wholesales from

the following tables by writing in matrix form.

	Basmati	Mansuli
Purchase	Rs 4000	Rs 3000
Delivery	Rs 550	Rs 550

I hope they will write the information in matrix from in the following ways

$A = \begin{bmatrix} 4000 & 3000 \\ 550 & 550 \end{bmatrix}$ to find the total cost from three different retailers they will add

$A + A + A = \begin{bmatrix} 4000 & 3000 \\ 550 & 550 \end{bmatrix} + \begin{bmatrix} 4000 & 3000 \\ 550 & 550 \end{bmatrix} + \begin{bmatrix} 4000 & 3000 \\ 550 & 550 \end{bmatrix}$

$= \begin{bmatrix} 4000 + 4000 + 4000 & 3000 + 3000 + 3000 \\ 550 + 550 + 550 & 550 + 550 + 550 \end{bmatrix} = \begin{bmatrix} 12000 & 9000 \\ 1650 & 1650 \end{bmatrix}$

I will help them if they will be in confuse, I will tell them there is another way to

find the same result which is as follow

$$3A = 3\begin{bmatrix} 4000 & 3000 \\ 550 & 550 \end{bmatrix} = \begin{bmatrix} 3 \times 4000 & 3 \times 3000 \\ 3 \times 550 & 3 \times 550 \end{bmatrix} = \begin{bmatrix} 12000 & 9000 \\ 1650 & 1650 \end{bmatrix}$$

From the above example they will be conclude that when a matrix A is multiply by a scalar then its elements will be r times of the elements of matrix A i.e

If A=$\begin{bmatrix} a & b \\ c & d \\ e & f \end{bmatrix}$ then rA= r$\begin{bmatrix} a & b \\ c & d \\ e & f \end{bmatrix}$=$\begin{bmatrix} ra & rb \\ r\,c & rd \\ re & rf \end{bmatrix}$

After completing this activity I will distribute another work sheet to find the value of A+3B, 4A-B and 3(A+B) from the given matrices A=$\begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}$ and B=$\begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}$ they will this problem solving activity within group and internalize individually. There will be assignment to test their individual achievement in the group work.

Homework

1. If A=$\begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}$ and B=$\begin{bmatrix} 2 & 3 \\ 0 & -5 \end{bmatrix}$ find the matrix 2A-3B.

2. If A=$\begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}$, B=$\begin{bmatrix} 2 & 3 \\ 0 & -5 \end{bmatrix}$ and C=$\begin{bmatrix} 2 & -3 \\ 1 & 5 \end{bmatrix}$ find the matrix 2A+3B-2C, 4A-3C, 6B-2C

3. If A=$\begin{bmatrix} 0 & 3 \\ -1 & 2 \end{bmatrix}$ and kA=$\begin{bmatrix} 2 & 2a \\ b & 20 \end{bmatrix}$ then find the possible values of k, a and b.

Eight day's activities: chart preparing, posting and presentation Date: 2073/3/20

Algebraic properties of matrix addition and multiplication of a matrix by a scalar closure, commutative, associative, identity, additive inverse, sA=As, s(rA) =(sr)A =r(sA), (r+s)A = rA+sA, r(A+B) = rA+rB.

To start today's activity I will prepare a chart of closure, commutative, associative, identity, additive inverse the properties with their examples and let them to discuss on these properties for 20 minutes. I will ask them to link these properties in matrix algebra.

Closure property

Let A and B are the matrices of same order them A+B is also the matrix of same order of A and B.

a) $\begin{bmatrix} 3 \\ 5 \end{bmatrix} + \begin{bmatrix} 9 \\ -2 \end{bmatrix} = \begin{bmatrix} 12 \\ 3 \end{bmatrix}$ b) $\begin{bmatrix} 12 & 7 & 4 & 3 \\ -5 & 7 & 5 & 6 \end{bmatrix} + \begin{bmatrix} 1 & -2 & 5 & 2 \\ 3 & -3 & 6 & 6 \end{bmatrix} = \begin{bmatrix} 13 & 5 & 9 & 5 \\ -8 & 4 & 11 & 12 \end{bmatrix}$

Here the order of all three matrices is same in both cases.

Commutative property

Let A and B are the matrices of same order then A+B=B+A

$A = \begin{bmatrix} 2 & 4 & 1 \\ 3 & 5 & 6 \end{bmatrix}$ and $B = \begin{bmatrix} 3 & 1 & 4 \\ 4 & -5 & -7 \end{bmatrix}$ then A+B = $\begin{bmatrix} 2 & 4 & 1 \\ 3 & 5 & 6 \end{bmatrix} + \begin{bmatrix} 3 & 1 & 4 \\ 4 & -5 & -7 \end{bmatrix}$

$= \begin{bmatrix} 2+3 & 4+1 & 1+4 \\ 3+4 & 5-5 & 6-7 \end{bmatrix} = \begin{bmatrix} 5 & 5 & 5 \\ 7 & 0 & -1 \end{bmatrix}$

B+A = $\begin{bmatrix} 3 & 1 & 4 \\ 4 & -5 & -7 \end{bmatrix} + \begin{bmatrix} 2 & 4 & 1 \\ 3 & 5 & 6 \end{bmatrix} = \begin{bmatrix} 3+2 & 1+4 & 4+1 \\ 4+3 & -5+5 & -7+6 \end{bmatrix} = \begin{bmatrix} 5 & 5 & 5 \\ 7 & 0 & -1 \end{bmatrix}$

Therefore A+B=B+A

Associative property

If A, B and C are the matrices of same order then (A+B)+C=A+(B+C)

Let $A = \begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}$, $B = \begin{bmatrix} 3 & 4 \\ 4 & -5 \end{bmatrix}$ and $C = \begin{bmatrix} -2 & 8 \\ -4 & 5 \end{bmatrix}$

Then A+B = $\begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix} + \begin{bmatrix} 3 & 4 \\ 4 & -5 \end{bmatrix} = \begin{bmatrix} 2+3 & 3+4 \\ 4+4 & 5-5 \end{bmatrix} = \begin{bmatrix} 5 & 7 \\ 8 & 0 \end{bmatrix}$

And (A+B)+C = $\begin{bmatrix} 5 & 7 \\ 8 & 0 \end{bmatrix} + \begin{bmatrix} -2 & 8 \\ -4 & 5 \end{bmatrix} = \begin{bmatrix} 5-2 & 7+8 \\ 8-4 & 0+5 \end{bmatrix} = \begin{bmatrix} 3 & 15 \\ 4 & 5 \end{bmatrix}$

After the discussion of 20 minutes I will ask to make a chart to present on closure and commutative property by group A commutative and associative by group B associative, identity by group C, identity and additive inverse by group D.

Ninth day's activities: group wise problem solving and presentations Date: 2073/3/21

I will divide the students in to four groups A, B, C and D. I will provide one marker pen and one poster for each group. I will ask them to do the following job.

Verify the algebraic properties of the matrix for group A, I will give the matrices

$A=\begin{bmatrix} 2 \\ -3 \end{bmatrix}$, $B=\begin{bmatrix} -6 \\ 4 \end{bmatrix}$, $C=\begin{bmatrix} -2 \\ 1 \end{bmatrix}$, r =1/2 and s = -4

For group B, A=[12   10], B=[−2   −4], C=[8   −4], r =3/2 and s=-4

For group C, A= $\begin{bmatrix} 1 & 3 \\ 4 & 5 \end{bmatrix}$, B=$\begin{bmatrix} 3 & -2 \\ 4 & 3 \end{bmatrix}$, C=$\begin{bmatrix} -2 & 6 \\ 3 & -5 \end{bmatrix}$ r =1 and s= -2

For group D, A=$\begin{bmatrix} -2 & 2 \\ 4 & 3 \end{bmatrix}$, B=$\begin{bmatrix} -3 & -2 \\ 4 & 4 \end{bmatrix}$, C=$\begin{bmatrix} -2 & 2 \\ 2 & -2 \end{bmatrix}$ r =1 and s= 2 and I will ask

them to verify.

➢ A+B is again a matrix of order 2×1

➢ A+B=B+A

➢ A+(B+C)=(A+B)+C

➢ Find the additive inverse of B

➢ Find the additive identity of B

➢ sA=As, s(rA)=(sr)A=r(sA), (r+s)A=rA+sA, r(A+B)=rA+rB

After the completion of their group work they will present on the whole class.

Tenth day activities: play way method   Date: 2073/3/22

Transpose of matrix:- I am planning to take today's class by play way method by the concept of learning with playing. For this method I will need player so I will bring all the students in play ground and ask them to make a team of 8 players called them a, b, c, d, e, f, g, ,h. I will ask the players to arrange in rectangular form they will arrange either in a row or in a column or making 2 rows and 4 columns or in 4 rows and 2 columns as shown below.

$$A=[a \quad b \quad c \quad d \quad e \quad f \quad g \quad h], \quad B=\begin{bmatrix} a \\ b \\ c \\ d \\ e \\ f \\ g \\ h \end{bmatrix}, C=\begin{bmatrix} a & b \\ c & d \\ e & f \\ g & h \end{bmatrix}, D=\begin{bmatrix} a & c & e & g \\ b & d & f & h \end{bmatrix}$$

Whatever their position, I will ask to remember them for example the position of student 'a' in above group D is a_{11} the position of 'b' in the same group is a_{12} and so on then I will ask them to change their position a_{11} to a_{11}, a_{12} to a_{21} and so on. Finally the arrangement will change as A→B, C→D then I will tell them about the transpose of matrix. After the completion of one step each student can take part on that activity they can make their own group of 2 or 3 or 4 and so on and they will sit in matrix form and again rearrange in transpose form if they get confuse I will help them. After 25 minute, I will bring all the students in class room and tell about the notation of the transpose of matrix. And distribute them the following work sheet. They will do the problem as far as possible. I will help them.

1. Find the transpose of the following matrices

    a. $A=\begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}$ b. $B=\begin{bmatrix} 2 & o \\ 1 & 4 \end{bmatrix}$

2. If $P=\begin{bmatrix} 4 & 2 \\ 1 & -5 \end{bmatrix}$ and $Q=\begin{bmatrix} -2 & 1 \\ 0 & 4 \end{bmatrix}$ find the matrices P^T+Q^T, $(P-Q)^T$ and $(2P)^T$.

3. Write the order of the transpose of the matrices, if the order of the matrix is 2×4, 5×3, 10×3.

Eleventh day activities: group wise problem solving properties of transpose

Date: 2073/3/24

In this class I follows the problem solving strategy to conduct the class for the problem solving strategies I will divide the students in four homogenous group of heterogonous students each group contains 5 students, I will give them Roll No. as 1, 2, 3,4, 5. I will provide the work sheet for each group as mention below.

Learning Text

Properties of transpose

For any matrices A, B of same order and scalar k, r

1. $(kA)^T=kA^T$ 2. $(A+B)^T=A^T+B^T$

3. $[k(A+B)]^T = kA^T + kB^T$ 4. $(A^T)^T = A$

5. $(A-B)^T = A^T - B^T$ 6. $krA^T = k(rA)^T = (krA)^T$

I will give to verify the above properties of the matrices by taking $A = \begin{bmatrix} 2 & 3 & 4 \\ 5 & 6 & 7 \end{bmatrix}$ and

$B = \begin{bmatrix} -1 & -4 & 4 \\ 7 & 6 & 3 \end{bmatrix}$ k=2 and r=3 for group A.

Group B will verify the same property by taking $A = \begin{bmatrix} 3 & 1 \\ 1 & 5 \end{bmatrix}$ and $B = \begin{bmatrix} 2 & 1 \\ 0 & 4 \end{bmatrix}$ and r=-3

k=2 Group C will verify the same property by taking $A = \begin{bmatrix} 2 \\ 3 \\ 6 \end{bmatrix}$ and $B = \begin{bmatrix} -4 \\ -3 \\ 5 \end{bmatrix}$ and r=-2/3

k=1/2 Group D will verify the same property by taking

$A = \begin{bmatrix} -1 & 6 & 9 \\ -2 & 3 & -2 \\ 3 & 2 & 1 \end{bmatrix}$ and $B = \begin{bmatrix} -1 & 6 & 9 \\ -2 & 3 & -2 \\ 3 & 2 & 1 \end{bmatrix}$ and r=-1 k=1

After the completion of their group work, I will rearrange the students roll number wise like roll number 1 of each group will seat together and so on. Then they will share their knowing to each other.

Twelfth day's activities: group wise problem solving   Date: 2073/3/26

Solving matrix equations

Today's class students will learn about the matrix equations like aA+bB=X and cA+dB=Y where A, B, X and Y are matrices of same order and a, b, c and d are any scalar. For this to storm the students brain and to bridge their knowledge I will ask to solve the problem like 2x+3y=5 and x-y=0. After the discussion on the process of solving the above two variables linear equation, I will introduce the matrix equations like aA+bB=X and cA+dB=Y. I will follows the lecture method and problem solving method to solve the matrices equation so first of all I will mention the rule to solve the simultaneous equations and to make them familiar on the rules I will choose one of the students and ask him to solve

$2A+B=\begin{bmatrix} 4 & 6 \\ -2 & -4 \end{bmatrix}$ and $A-2B=\begin{bmatrix} 8 & 4 \\ -6 & 4 \end{bmatrix}$ on board. If he get confuse I will help him

other students will look his work and become clear about the rules. After completion

of this activity, I will divide the class in to 4 groups and provide one chart paper for

each group to solve the following equations and present to the class to make clear

about the solving process of matrix equations.

I will give the following problems.

For group A, solve $3A+2B=\begin{bmatrix} 2 \\ 4 \end{bmatrix}$ and $2A-B=\begin{bmatrix} 3 \\ 5 \end{bmatrix}$

For group B, solve $3X+2Y=\begin{bmatrix} 2 & 3 \end{bmatrix}$ and $2X-3Y=\begin{bmatrix} -5 & 2 \end{bmatrix}$

For group C, find matrix A such that $A+3B=\begin{bmatrix} 1 & 3 & 3 \\ 4 & 6 & 5 \\ 2 & 6 & -1 \end{bmatrix}$ and $B=\begin{bmatrix} -2 & 5 & 3 \\ -3 & 3 & 3 \\ 2 & 2 & -8 \end{bmatrix}$

For group D, find matrix X such that $2X-Y+3Z=\begin{bmatrix} 2 & 3 \\ 4 & 5 \end{bmatrix}, Y=\begin{bmatrix} -2 & 3 \\ 3 & 6 \end{bmatrix}$ and $Z=\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$.

Appendix F Time schedule for traditional group

S.N.	Topic	Period
1	matrix and its notations	2
2	some special type of matrices	2
3	equal matrices	1
4	addition and subtraction of matrices	2
5	multiplication of matrices by a scalar	1
6	algebraic properties of matrices	1
7	solving matrix equation	1
8	transpose of matrices	1
9	properties of transpose	1
	total period	12

Appendix G Pre-test & Post-test achievement score of participant students

	achievement score of pre-test		achievement score of post-test	
students	experimental groups	control groups	experimental groups	control groups
1	7	8	30	27
2	8	5	28	26
3	6	7	26	21
4	5	6	21	18
5	5	4	17	12
6	4	3	20	14
7	3	4	12	10
8	4	5	10	10
9	2	2	27	14
10	2	1	27	16
11	2	1	26	12
12	1	2	27	15
13	2	2	26	6
14	2	1	24	6
15	2	1	18	14
16	2	2	18	13
17	1	2	19	12
18	1	2	24	15
19	1	2	20	18
20	1	3	22	9