TEACHERS' PERCEPTIONS AND PRACTICES OF ACTIVE LEARNING IN MATHEMATICS CLASSROOM

A

THESIS

BY

BIRENDRA SINGH PALI

FOR THE PARTIAL FULFILMENT OF THE REQUIREMENT FOR THE DEGREE OF MASTER OF EDUCATION

SUBMITTED

TO

DEPARTMENT OF MATHEMATICS EDUCATION

CENTRAL DEPARTMENT OF EDUCATION

UNIVERSITY CAMPUS

TRIBHUVAN UNIVERSITY

KIRTIPUR, NEPAL

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शिक्षा शास्त्र केन्द्रीय विभाग
गणित शिक्षा विभाग

विश्वविद्यालय क्याम्पस
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UNIVERSITY CAMPUS
Kirtipur, Kathmandu, Nepal

TRIBHUVAN UNIVERSITY
CENTRAL DEPARTMENT OF EDUCATION
DEPARTMENT OF MATHEMATICS EDUCATION

पत्र संख्या:-
Ref.

मिति:
Date: .....

LETTER OF CERTIFICATE

This is to certify that Mr. Birendra Singh Pali a student of academic year 2070/1 with campus Roll Number 328, Thesis Number 1232, Exam Roll Number 280391 (2073) and TU registration number 9-2-329-192-2007 has completed this thesis for the period prescribed by the rules and regulations of Tribhuvan University, Nepal. This thesis entitled '**Teachers' Perceptions and Practices of Active Learning in Mathematics Classroom'** has been prepared based on the results of his investigation. I, hereby recommend and forward that his thesis be submitted for the evaluation as the partial requirements to award the degree of Master of Education.

.....

Assoc. Prof. Laxmi Narayan Yadav

(Head)

Date.....

Phone No.: 977-1-4331337 / 4333229, Fax No.: 4334955, E-mail : foe@tucded.edu.np, Website : tucded.edu.np

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Date: .....

LETTER OF APPROVAL

This thesis entitled "**Teachers' Perceptions and Practices of Active Learning in Mathematics Classroom**" submitted by Mr. Birendra Singh Pali in partial fulfillment of the requirements for the Master's Degree in Education has been approved.

Viva Voce Committee	**Signature**
1.Assoc. Prof. Laxmi Narayan Yadav (Chairman)	……..
2. Prof. Dr. Hari Prasad Upadhyay (External)	……
3. Mrs. Hom Kumari Adhikari) (Member)	……

Date……

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Date: .....

RECOMMENDATION FOR ACCEPTANCE

This is to certify that Mr. Birendra Singh Pali has completed his M. Ed. thesis entitled **"Teachers' Perceptions and Practices of Active Learning in Mathematics Classroom"** under my supervision during the period prescribed the rules and regulations of Tribhuvan University, Kirtipur, Kathmandu, Nepal. I recommended and forward his thesis to the Department of Mathematics Education to organize final viva-voce.

.....

(Mrs. Hom Kumari Adhikari)

Supervisor

Date: ……..

Phone No.: 977-1-4331337 / 4333229, Fax No.: 4334955, E-mail : foe@tucded.edu.np, Website : tucded.edu.np

Defence Date: 24th May 2018

DEDICATION

To My Parents

DECLARATION

This dissertation contains no material which has been accepted for the award of other degree in any institutions. To the best of my knowledge and belief, this thesis contains no material previously published by any authors except due acknowledgement has been made.

……

Birendra Singh Pali

Date: ……

ACKNOWLEDGEMENT

I dedicate my sincere gratitude to a few people for their conceptual, moral and technical support to shape this dissertation. At first, I would like to extend my deep gratitude to my dissertation supervisor Mrs. Hom Kumari Adhikari. Her full guidance and support helped me to shape this dissertation.

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I would like to express my deepest gratitude to my parents who always encourage me to continue my higher studies. I would like to thank all the concerned Principals and mathematics teachers of Kathmandu district who provided me their valuable time and appropriate environment to collect the data of this research.

Finally, my obligation goes to all my friends especially for their suggestion and co-operation for preparing the research work. I cannot stay without giving special thanks to my family for providing me economic support as well as in valuable support.

……..

Birendra Singh Pali

ABSTRACT

The primary objective of the study was to explore the mathematics teachers' perceptions and practices of active learning in the mathematics classroom. Also, the study has identified the constraints that hinge on the implementation of active learning in the mathematics classroom. The researcher used an explanatory sequential mixed research design using simple random sampling techniques to complete the study. The researcher selected 102 mathematics teachers from 50 (institutional and community) schools. The researcher administered the questionnaire as the survey over 102 mathematics teachers. Then the researcher selected six teachers from 102 teachers based on purposive sampling method to observe classroom: 30 lessons were observed while teachers were practising mathematics in the actual classroom using observation protocol. Also, a semi-structured interview was conducted with six mathematics teachers whose mathematics classes were observed. The researchers analysed the data using the inferential statistics performing SPSS 21.0. The findings of the study explored that the mathematics teachers had perceived active learning positively in the mathematics classroom. Despite the positive perceptions, the implementations part of active learning was poor. Moreover, the most common factors affecting the implementation of active learning in mathematics were lack of sufficient time and a shortage of teaching aids in the classroom. It is affirmed that active learning in mathematics demands new structure in the national curriculum and management of classroom setting because it calls for the use of wide range of innovations in mathematics learning. Therefore, it is necessary to restructure and up to date the education system in accordance with active learning.

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ABBREVIATIONS

NCF = National Curriculum Framework

NCTM = National Council of Teacher of mathematics

SPSS = Statistical Package for Social Science.

Chapter-I

INTRODUCTION

Background of the Study

With the goal of promoting active learning for mathematics by integrating innovative teaching approaches and styles, the national curriculum of the mathematics of Nepal has been changed to integrate the courses in accordance with Active Learning. The providing opportunities to the students in the mathematics classroom can play a vital role in practical mathematics instruction. Effective mathematics instruction is supposed to be successful only when students get higher achievement in mathematics mastering over the higher order thinking skills. One of the critical variables that contributed students' achievement is the participation of students in the learning process, actively, including the organisation of learning experience and planning their instruction (Good and Brophy, 2006). The phase of teaching and presentations skills of teachers are also crucial in active learning for mathematics. Panthi and Belbase (2017) stated that the pedagogical choice of teachers to engage students in higher-order thinking, reasoning, and problem-solving has a direct influence on their performance. Due to the advancement of technology in mathematics instruction, it has become relatively easy to implement the active learning for teaching new ideas and concepts of mathematics in the classroom.

However, in Nepal, mathematics teachers generally, use a traditional approach such as lecture method and transmission approach (Panthi and Belbase, 2017) to introduce a new concept of mathematics in their classroom. Freire (2003) described this approach as a banking method in which student's mind is a bank and teacher as the processor of knowledge. Johnson and Johnson (1997) specified that, in the traditional way of teaching, students often are passive recipients of knowledge rather

than being active participants due to teachers' inclination to talk at students and how students interact with one another is a relatively neglected aspect of instruction. This method is not suitable for mathematics learning because it may be unfair to some students just to continue lecturing and not giving them the opportunity for reflecting on what they learned (Panthi and Belbase, 2017). Moreover, this pedagogy encourages to develop cognitive skills rather than higher order thinking and diverse application.

The worldwide trend of the use of students centred learning in mathematics and the framework of NCTM (2000) stated: “Teachers’ actions are what encourage students to think questions, solve problems, and discuss their ideas, strategies, and solutions (p.18).” These activities encourage the active learning in mathematics to develop mathematical creativity, visual thinking, curiosity, and algebraic thinking and all higher order thinking skills and make relatively easy for hard to teach aspects of mathematics.

Abiding such worldwide trend and the framework, Basic Mathematics Curriculum (2005; 2008; 2012) of Nepal has encouraged the mathematics teachers to be a facilitator in the mathematics classroom. Moreover, mathematics curriculum also emphasises student centred activities in the classroom such as pair work, investigation, individual work, project work that enhance the higher ability skills such as creativity in mathematics. In this point of view, many educators, mathematics educators, and educational plans and provision espouse the active learning approach in education, and more significant attention has been given to shift the teacher-centred approach to a student centred one. This attention is also spot-on in case of Nepal that the National Curriculum Framework (NCF, 2007) promotes active learning in math curriculum.

Despite the mathematics curriculum that suggests student-centred and active learning, the teachers are adopting a traditional chalk-and-talk approach in Nepalese schools (Nakawa, 2013). This trend may be lack of the use of technology in mathematics classroom because the use technology has not widely used yet in mathematics classroom of Nepal (Bist, 2017). In case of mathematics learning, Nepali students still well in cognitive skills but weaker in the application and higher ability skills and the situation urges that more concentration on improving the pedagogical process be needed at basic level mathematics to improve students' achievement in mathematics (Education Review Office, 2016). Therefore, this study has attempted how mathematics teacher perceived active learning in mathematics and what are the significant factors that hinge on the implementation of active learning in the classroom.

Statement of the Problem

Active learning in mathematics refers to classroom practices that engage students in a range of activities such as creative activities, individualised instruction, problem-solving that promote higher order thinking skills. It encourages students' participation in each phase of mathematics instruction and, however, the teachers' preferred methods for teaching contents of mathematics guide learning activities of students in the classroom. Teachers have been encouraged through training and professional seminars to provide an ample opportunity to the students in the learning process (NCF, 2007) using student-centred methods.

However, the mathematics curriculum provisioned, and teacher training advocated active learning for decades, the students have still lacked the understanding the procedural knowledge of mathematics, and so weaker in its application in real problem-solving. It seems the real practices of active learning for mathematics may

have some constraints that hinge the successful implementation of active learning in the mathematics classroom.

There would be a range of constraints such as students and teachers willing to follow the active learning in the mathematics classroom and the use of technology in the classroom. Some of the factors are connected with the pressure of the curriculum, unfitting classroom organisation and management, lack of trained teachers, lack of support from top officials, perceptions of active learning and the problem with the students (Plass, 1998, Leu, 1998; as cited in Geressu, 2008).

It is known that dearth use of innovative teaching aids could be main constraints of successful implementation of active learning in the mathematics classroom. It enforces teachers to use traditional lecture method in every content of mathematics in the classroom learning. It means that the active learning in mathematics classroom has not been implemented efficiently in Nepal yet.

Despite the dissemination of active learning for mathematics through training and a range of national and regional seminars, there are some constraints to be identified which hampered the proper implementation of active learning approaches in Nepalese schools. Therefore, there was necessary to conduct a study to explore the teachers' perception and practice of active learning in the mathematics classroom. Moreover, this study intended to seek an answer to the following research questions:

- How does the math teachers perceive active learning in mathematics classroom?
- How often do math teachers practice active learning methods in mathematics classes at the basic level?
- What are the affecting factors of successful implementation of active learning in math learning?

Objectives of the Study

The primary objective was to explore the mathematics teachers' perceptions and practices of active learning in the mathematics classroom. This objective is clarified in the following:

- To assess the teachers' perceptions about active learning.
- To explore how often mathematics teachers practice active learning methods in the classroom at basic level.
- To find out the factors affecting the implementation of active learning in the mathematics classroom.

Significance of the Study

The study of this type may be useful to the mathematics educators, policy makers, curriculum planners and the implementers (the teachers). The finding of this research shall have the following benefits:

- Since the participants of the study are mathematics teachers of Kathmandu valley including institutional and community, the research shall benefit them to examine their perception and practices of active learning.
- It could appraise of the affecting factors of implementation of active learning in mathematics and re-plan for making panacea for it.
- It would be useful to encourage active learning in mathematics learning at basic level.
- Furthermore, this study can contribute to improving the mathematics achievement of students by preferring the best pedagogical choice for contents of mathematics.
- This study would be beneficial to the teachers learn about the examples of active learning practices for mathematics.

Delimitation of the Study

This study was also following delimitations:

- This study was conducted in basic level (grade one to eight).
- This study was concerned the basic level mathematics teacher of community and institutional schools in Kathmandu Valley.
- This study contained 102 mathematics teachers of 50 schools located in Kathmandu valley (including, Kathmandu, Bhaktapur and Lalitpur Districts).
- The researchers used the questionnaire, a semi-structured interview and classroom observation protocol as data collection tools.
- In the classroom Observation, the researcher had only focused on what happens in the classroom and on the strategies to teach mathematics.
- The questionnaire and interview guide had to be transcribed from English to Nepali, and this took more time than the researcher anticipated.

Definitions of the Key Terms

Active learning. Active learning refers to the classroom practices that engage students in activities to enhance higher order thinking skills. Generally, the active learning follows the following steps:

Think. In this phase, students are encouraged to think about the posed problems and its relationship with previous solutions and problem. In this step, the mathematics teacher supports the students to use their past and current state of knowledge and experience.

Pair. In this phase, the students are encoured to work on group to reach the solution.

Share. In this phase, the students are encouraged to share their solutions among the groups. Sharing is important in active learning because it encourages the students to develop versatile mathematical communication.

Perception. In this study, perception refers to the process of using the senses to acquire information about the surrounding environment of situation. In other words, views or opinions held by an individual resulting from experience and external factors acting on the individual.

Classroom Practice. In this study, the classroom practices mean what really takes place in the mathematics classroom into which teacher and students are practising mathematics. It refers to everything that goes in the mathematics classroom.

Basic Level. The basic level refers one to grade eight school, according to National Curriculum Framework of Nepal.

Community school. Community School refers to any schools those have approved with receiving a regular grant from Government of Nepal.

Institutional school. Institutional School refers to those schools that have obtained approval or permission for operation on condition but not receiving regular grants from Government of Nepal.

Chapter-II

REVIEW OF RELATED LITERATURE

A literature review is the summary of journal articles, books and, other documents, which expresses about the past and current state of information on the topic which is going to be studied (Creswell, 2014). It supports the researcher to identify the gap in the literature and makes the research more significant. So this chapter conveys the empirical review of the literature, theoretical review of the literature and conceptual framework.

Empirical Review

An empirical review of the literature refers to the review of the empirical research which is based on empirical evidence. Empirical research is a way of identifying or generating knowledge using the means of direct and indirect observation or experience. In the empirical review of the literature, the research underscored the empirical evidence (the record of one's direct observations or experiences) analysed quantitatively or qualitatively, data, research design and result or answer of the empirical. It helps the researcher to find out the gap and possible research techniques and tools to be used in this study. Thus, the empirical literature related to study area has been reviewed as below:

Nasrini (2016) carried out research entitled on “primary mathematics teachers perceptions toward mathematics weekly computerised test” to find out the teachers perceptions towards computerised test in mathematics. The study was complemented with mixed methods using interview and questionnaire as the data collection tools. The findings of the study showed that primary teachers had positive toward the weekly computerised tests and the teachers believed that it would be a better

diagnostic tool than the paper-pencil assessment concerning saving the time and on spot feedback.

Bhattarai (2016) carried out the research entitled on "mathematics teachers perception towards mathematics" to find out the perception of secondary level mathematics teachers towards mathematics and to compare the perception of secondary level mathematics teachers towards mathematics gender and discipline wise. For the study, the researcher selected 20 public schools with 31 teachers and ten private schools with 19 teachers randomly from Banke district. The questionnaire form and interview guideline were the data collection tools of the study. Using cross-validation method, the researcher identified that teachers had a positive perception of mathematics.

These two research focused on the teachers' perception towards the mathematics. Moreover, the focused area was the assessment system using various tools and techniques and contents of mathematics. Bhattari (2016) compared the male and female teachers' perceptions towards mathematics. However, it had not been seen that the pedagogical choice of mathematics teachers for mathematics teaching.

Freeman and colleagues (2014) conducted a meta-analysis of 225 studies comparing “constructivist versus exposition-centred course designs” in STEM disciplines. They included research which examined the design of class sessions (as opposed to out-of-class work or laboratories) with at least some active learning versus traditional lecturing, comparing failure rates and student scores on examinations, concept inventories, or other assessments. The results indicated that students in traditional lectures were 1.5 times more likely to fail than students in courses with active learning. Further, they investigated that on average, student performance on

exams, concept inventories, or other assessments increased by about half a standard deviation when the teacher included some active learning in course design.

Dhakal (2014) has done research on topic "Student centred teaching method teachers' perception and their practices" to explore the teachers' perception and practices of student centred teaching method and to find out the ways to guide teachers to be more effective in their profession through practising students centred styles in their classroom. This study was carried out based on interpretive paradigm using the qualitative method. The findings of the research indicated that should play an active role in an educational setting to participate students actively in the classroom.

Similarly, Ruiz-Primo and colleagues (2011) examined published studies examining the effects of active learning approaches in undergraduate biology, chemistry, engineering and physics courses. They identified 166 studies that reported an effect size when comparing the effects of active learning approaches that included the innovation to traditional instruction. Overall, they explored that inclusion of the active learning approaches improved student outcomes (mean effect size = 0.47), although there are notable caveats to consider. First, the researchers coded the active learning activities as conceptually preoccupied with tasks, collaborative learning activities, technology-enabled activities, inquiry-based projects, or some combination of those four categories, and essential differences existed within the groups such as for technology-assisted inquiry-based projects did not produce positive effects, on average. Second, more than 80% of the studies encompassed with quasi-experimental rather than experimental, and the positive benefits (average effect size = 0.26) were inferior for the experimental studies in which students were randomly assigned to a treatment group.

Finally, many of the research did not include control pre-existing knowledge and abilities in the treatment groups. Nonetheless, the review does provide qualified support for the inclusion of active learning approaches in instruction.

Teshome (2012) conducted a study entitled on "Teachers' Perceptions and Practices of Active Learning in Haramaya University, Eastern Ethiopia: The Case of Faculty of Education". To explore instructors' perceptions and practices of active learning, examine the extent to which instructors' perceptions influence their practices and identify influencing factors of implementation of active learning in Haramaya University faculty of education were the objectives of the study. The researcher employed descriptive survey design. The questionnaire was conducted over a total of 123 instructors. A qualitative approach complemented the study using observation checklists and interviews for data collecting: 9 lessons were observed while the instructors were teaching in the actual classes. The three instructors were taken to react to the question form of a semi-structured interview. The sampling technique was purposive and systematic sampling techniques.The Descriptive statistics (mean, standard deviation, and percentage) were used to analyse the data. The findings of the study exposed that the respondents had perceived active learning positively. Moreover, the common factors affecting the effective implementation of active learning were instructors' tendency toward the traditional/lecture method, lack of students' interest, shortage of time, lack of instructional material and large class size.

Kartina and colleagues (2011) carried out a study entitled "Active Learning and Student Engagement in Mathematics at Madrasah Ibtidâ'iyah Al-Jauharotunnaqiyah" to find out the challenges teachers faced in teaching for active learning and to teachers to use active learning in the mathematics classroom. The qualitative data were collected through interviews, focus groups, and classroom

observations. The research findings specified that only a few teachers were familiar with the active learning, and even smaller number are ready to try it out. Moreover, they outlined that the socioeconomic background of the students as a factor inhibiting teachers' ability to use active learning strategies.

Kyriacou (1992) conducted the study entitled "Active Learning in Secondary School Mathematics" in two phases. Seven categories of the activities used in math lesson were identified for the first phase of research. One activity was considered to describe traditional teaching and other six to describe active learning. The researcher asked the heads of mathematics departments to complete the questionnaire that comprised in which they assessed the frequency of occurrence of these seven doings, in the second phase of the study.

The findings indicate that active learning is now commonplace now, but, in most schools, only the minority of lessons. Also, the responses indicated a marked shift towards the more excellent use of active learning in nowadays, particularly in the use of investigational tasks, small group debate, computer-assisted learning and protracted project work.

Chaisir (2012) did the research entitled on "Teachers perception of quality mathematics teaching." to find out the teachers perception of quality mathematics learning. This study was based on the descriptive survey design. To collect information, five teachers including administrator as well as trainers were taken as the participants. Using interview with the participants, the finding of the research showed that learning process and pillars of leaning such as teachers, students and school climate as the dimensions of quality of math learning.

From the review of this literature, it has been seen that much of the research focus on the teacher's perception towards mathematics. However, the pedagogical

choice of teachers in the classroom may direct the mathematics instruction. Student centred learning initiated the active learning in the classroom that provides boundless opportunities to the mathematics learners. Active learning methods have a positive impact on the learning of students (Braun, 2016). There may be a set of affecting factors that made difficulty in successful implementation of active learning in mathematics this is also under the study. Therefore, this study was focused on identifying the teachers' perceptions and practices of active learning in mathematics learning. Apart from that this study also focused on identifying the constraints that influence the use of active learning in mathematics instruction.

Theoretical Framework

This study was based on constructivism approach to learning. "Constructivist learning theory underscores that individuals learn through constructing their own knowledge, connecting new ideas and experiences to current knowledge and experiences to form new or enhanced understanding" (Bransford et al., 1999; as cited in Brame, 2016, p. 2). The theory, developed by Piaget and others, theorises that learners can either assimilate new information or ideas into an existing structure or can modify that structure to accommodate new information or ideas that contradicts previous understanding. The influence of constructivist theorists' work in contemporary math is seen clearly, because of its use in classroom and research setting. Jorgensen and Dole (2011) have emphasised that there are some different forms of constructivism, but underpinning all versions are three premises:

- Knowledge is actively constructed by students rather than being passively received.
- Mathematical knowledge is created by students as they reflect on their physical and mental actions. By observing relationships, identifying patterns

and making abstractions and generations, students come to integrate new knowledge into their existing mathematical schemas.

- Learning math is a social process where, through dialogue and interaction, students come to construct more refined mathematical knowledge. Through engaging in the physical and social aspects of math, students come to construct more robust understandings of mathematical concepts and processes through processes of negotiation, explanation and justification (pp. 23-24).

Also, they avowed that it recognises that mathematics must make sense to students if they are to retain and learn mathematics. Methods that promote active learning often explicitly ask students to make connections between new knowledge and information and their current intellectual models, extending their understanding. In other cases, teachers may design learning activities that allow students to confront misconceptions, helping students reconstruct their conceptual representations based on more precise understanding. In either case, approaches that support active learning promote the kind of cognitive work identified as indispensable for learning by constructivist learning theory (Brame, 2016).

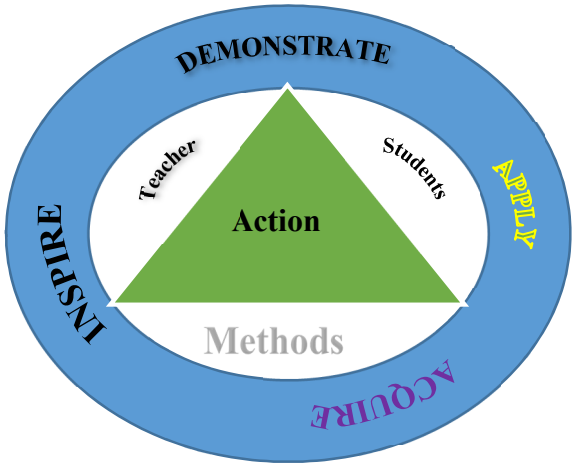
Active learning approaches also often embrace the practice of cooperative learning groups, a constructivist-based exercise that keeps particular stress on the contribution that social interaction can make (Brame, 2016). Lev Vygotsky's work clarified the relationship between cognitive processes and social activities and commanded to the sociocultural theory of development, which proposes that learning takes place when students start to mathematical or daily life problems beyond their current developmental level with the support of their tutors or their peers (Vygotsky 1978; as cited in Brame, 2016). Thus active learning approaches that rely on group work rest on this sociocultural branch of constructivist learning theory, leveraging

peer-peer interaction to promote students' development of extended and accurate mental models.

Conceptual Framework

The active learning for mathematics is based on constructivism theory of learning. In this study, the researcher used the conceptual framework designed concerning the characteristics of constructivism learning to examine the active learning practices in the mathematics classroom. The active learning is the student centred approach, in which students take responsibility for learning and teachers facilities the learning environment. It is assumed that students should be provided ample opportunities to practice mathematics to enhance higher order thinking skills.

Using the core assumptions of constructivism theory of learning, the learning cycle of active learning has been captured in the following conceptual framework:



Active Learning Cycle

The above framework shows that active learning cycle. In this framework, the action is central to the learning process. For the purpose of identifying the teachers' perception and practices of active learning in the mathematics classroom. The

researcher measured these aspects regarding the above frame of learning. It seems clear that the learning is a continuous process where students and teachers work on different activities as the form of action.

According to the diagram, the choice of methods determines the actions and hence influence the acquisition of mathematical knowledge and its application to the required sectors. The teacher encourages students to engage in the activities actively and supports in a demonstration of knowledge and skills. Inspiration strengthens the nexus connection among the learners, teachers and the preference of learning styles and methods in the active learning classroom. The choice of methods also determines the use of materials and access to different kinds of modes of engaging in learning activities. The demonstration of the solution or construction of knowledge helps the sharing the knowledge among the classroom. Then, the students acquire the new knowledge based on their conclusion. This framework demonstrates the classroom of the active learning cycle, the researcher intended to measure the teachers' perception and practices of active learning in the mathematics classroom based on this frame of learning.

Chapter- III

METHODS AND PROCEDURES

This chapter encompasses the research design, research method, and the total population of the study and the samples of the study with the selection mechanisms. Also, it comprises the sources of data collection, data collection tools, reliability and validity of tools, data collection procedures and finally, the data analysis and interpretation procedures. Apart from the data section, this chapter conveys the ethical considerations that the researcher considered throughout the research process, as in the last section.

Design of the Study

The researcher used the mixed methods which make the connection between quantitative and qualitative approach. "A mixed method research design is a procedure for collecting, analysing, and mixing both quantitative and qualitative methods in a single study to understand a research problem" (Creswell, 2014, 535). The most important reason for adopting this mixed methods of the study was the understanding of the perception of teachers' toward active learning in the mathematics classroom. The researcher used descriptive survey for collecting quantitative data, in the first phase of the study and in the second phase, the researcher used case study for collecting qualitative data. Thus, the study has become an explanatory sequential mixed method design. This approach assists the researcher to come up with the findings that are more comprehensive, integrates various aspects of the problem investigated. The researcher was adopting the descriptive survey design for the perception.

Population and Sample of the Study

The population of the study was the mathematics teachers those have been teaching mathematics at basic level in the Kathmandu Valley.

The sample of the study comprised 102 mathematics teachers from fifty (government and institutional) schools in Kathmandu district. This sample was selected based on simple random sampling techniques. Then the researcher had selected the six teachers to observe their classroom based on the purposive sampling technique. Moreover, the researcher conducted the semi-structured interview with those participants whose classroom was observed.

Tools of the Data Collection

To collect primary data from the subjects of the study, the researcher used different data collection instruments to collect both quantitative and qualitative data. In fact, the researcher employed questionnaire, interview, observation and document analysis for the study to collect primary and secondary data.

Questionnaire. To collect the relevant data, the researcher administered the questionnaire to find out the teachers perception toward the implementation of Active Learning in the mathematics classroom. Likert's scale. For this study, the researcher modified the questionnaire developed by Mulatu and Bezabih (2018) with the support of the supervisor. The questionnaire consisted 38 items in the combined form of five and three points Likert's scale, after ensuring the validity and reliability. The questionnaire was divided into four section first three sections were based on five-point Likert scale whereas the fourth section was based on three-point Likert's scale. The first three section consisted 31 items, and the fourth section consisted only seven items.

To calculate the reliability of the questionnaire, the researcher conducted a pilot study among 35 mathematics teachers that represent that population of the study but not included in the sample. The questionnaire consisted 45 items. Then the researcher calculated reliability coefficient, Cronbach's Alpha, performing SPSS 21.0. The Cronbach's Alpha was 0.83 which is high. The validity of the questionnaire was ensured by the expert judgement. The researcher retained 38 items for this study.

The scoring format of five point Likert scale is presented in the following table:

Positive Statements	Scale value	Negative Statements	Scale Value
Strongly Agree	5	Strongly Agree	1
Agree	4	Agree	2
Neutral	3	Neutral	3
Disagree	2	Disagree	4
Strongly Disagree	1	Strongly Disagree	5

The scoring format of three point Likert scale is presented in the following table:

Positive Statements	Scale value	Negative Statements	Scale Value
Not Serious	1	Not Serious	3
Serious	2	Serious	2
Most Serious	3	Most Serious	1

Observation Protocol. To understand the depth of classroom practices of and challenges faced by a math teacher in the classroom while teaching for active learning, the researcher used observation form. The researcher used the observation form developed by Central Department of Education (2016), Tribhuvan University, Kirtipur, after modifying its some dimensions. In the observation form, the researcher focused on active learning practices in the actual classroom setting of math learning. There were three parts in the observation form, such as instructional methods, teaching materials and learning climate. The form consisted 18 statement in total in which six belongs to each part. To confirm the validity and reliability of the observation form, a draft of the observation form were distributed to senior teachers and the supervisor.

Semi-Structured Interview. To identify the factors affecting the successful implementation of active learning, the researcher developed the semi-structured interview with the help of a supervisor. There were seven questions in the interview. The interview questions were open-ended. In this regards the interview was focused on exploring the constraints of implementation of active learning in mathematics learning. Moreover, the interview questions were connected to each section of the questionnaire to get in-depth information from the participants.

Data Collection Procedures

The researcher proceeded the data collection by granting the permission from the principal and mathematics teachers of the sampled schools. In the initial phase of data collection, the researcher accumulated the numbers of mathematics teachers engaged in practising mathematics at basic level in the Kathmandu valley (Kathmandu, Bhaktapur, Lalitpur Districts). The researcher then visited the schools and requested for conducting the study by clarifying the purpose of the study. After

that the researcher used short briefing to the individual participants about how to use questionnaire and distributed the questionnaire to the 102 sampled teachers.

After collecting the questionnaire from all participants, the researcher selected six from 102 teachers based on purposive sampling method to visit their class and to conduct the interview. The researcher observed five /five full mathematics class of each six participants using observation protocol. During the classroom observation, the researcher did not ask any questions to the teachers and students and did not interfere with learning activities. Finally, the researcher conducted the semi-structured interview with these six participants whose classroom were observed. The interview was recorded on the electronic device (recorder). The data collection process took two months.

Data Analysis and Interpretation Procedures

After completion of the data collection, the researcher organised the data using computer database. The data obtained from the questionnaire was coded that it was fitted with the SPSS 21.0 for calculation frequency and percentage. In fact, the researcher used SPSS 21.0 to calculate the inferential statistics. The analysis and interpretation of the questionnaire data were based on frequency and mean of each item assigned by the participants. The researcher interpreted the percentage of the majority and the mean of each items using the interpretation criteria provided by Hull and Wie (1986) (as cited in Arthur, 2010). The researcher used interview data to enrich the analysis and interpretation of the results of the questionnaire. In fact, the researcher analysed the results of both questionnaire and interview data together. Then the researcher codes the observation data using a computer and thick description was assumed as the secondary theme. Based on the thematic approach the researcher generated the primary theme based on a secondary theme. Finally, the interview data

were triangulated with conceptual framework and questionnaire and observation, according to their suitability.

Ethical Considerations

In this study, the researcher considered some of the ethical issues that ensure the standardisation of data collection process and conformity the reporting the study findings. The following ethical issues were considered throughout the study:

- The researcher granted permission from the institution before planning or conducting the study.
- The researcher had informed consent to participants for conducting the study. In other words, the participants were apparently informed about the study and duration of the study as well as possible risk factors occur during the observation. During the classroom observation, the researcher did not make hindrance in the learning process.
- The researcher had informed consent in recording the interview.
- The researcher neither fabricated the data nor did falsify in the reporting.
- The researcher had used appropriate language that was reasonably understandable to the participants.

Chapter-IV

ANALYSIS AND INTERPRETATION OF DATA

This chapter presents and discusses the results of the research. After acquiring the data from research venue using the questionnaire, observation protocol and interview with the participants, the researcher started to analyse the data and answer the research questions. The researcher employed various statistical methods to analyse the data. The analysis of the data completed in two comparative phases. First, the researcher analysed the questionnaire data, and to supplement and enrich the information that was drawn using questionnaire, the result of the interview and observation protocol was described in the second phase. The researcher analysed and interpreted the result of questionnaire and interview together in the first part of this chapter and analysis and interpretation of observation data in the second part of this chapter.

Analysis interpretation of questionnaire and interview data

There were 38 items in this question across the four sections. The semi-structured interview consisted seven open-ended questions. The interview questions were designed to capture the information related to each section of a questionnaire that questionnaire overlooked in its statements. To enrich the analysis and interpretation of the data, the researcher analysed and interpreted the results of questionnaire and interview together.

Teachers' perceptions of Active Learning in Mathematics Classroom.

There were ten items in this section of the questionnaire. Moreover, this section of the questionnaire consisted the statements related to the assumptions about active learning, advantages of active learning. Then, the sample group of the teachers of mathematics were asked to respond to these statements. For analysis, the researcher

calculated the percentage and mean of each item assigned by the respondents. Moreover, the researcher assumed that Strongly Agree (SA) and Agree (A) as the Agree, Neutral (N), and Strongly Disagree (SD) and Disagree (D) as Disagree. Also, the researcher added the analysis of related interview data with the interpretation of this section of the questionnaire. The mean and percentage of each item are presented in the following Table I:

Table I: Teachers' perceptions of Active Learning in Mathematics Classroom.

SN	Items	SA	A	N	D	SD	Mean
1	The quality of education can be improved if teachers shift their instruction from the lecture methods to Active Learning Methods	69 (67.6 %)	13 (12.7%)	10 (9.8 %)	6 (5.9 %)	4 (3.9%)	4.3
2	Active learning enhances students' level of understanding and involves them in problem-solving	83 (81.4 %)	8 (7.8 %)	4 (3.9 %)	5 (4.9 %)	2 (2%)	4.6
3	Active learning creates the opportunities to share experiences and encourage friendship among students.	71 (69.6 %)	6 (5.9 %)	15 (14.7%)	8 (7.8 %)	2 (2 %)	4.3
4	Active learning enhances active involvement of students in learning instead of passive listening.	93 (91.2 %)	2 (2 %)	-	5 (4.9 %)	2 (2 %)	4.7

5	Active learning enhances self-confidence and independent learning of students	74 (72.5 %)	3 (2.9 %)	16 (15.7%)	9 (8.8 %)	-	4.3
6	Teachers must encourage students to communicate effectively	63 (61.8 %)	14 (13.7%)	18 (17.6%)	3 (2.9 %)	4 (3.9%)	4.3
7	Active learning offers opportunities for the progress of students' in the application of mathematics.	60 (58.8 %)	5 (4.9%)	28 (27.4%)	6 (5.9 %)	3 (2.9%)	4.1
8	Active learning prepares students for active participation in the lesson	59 (57.8 %)	7 (6.9 %)	23 22.5%)	10 (9.8 %)	3 (2.9%)	4.0
9	Active learning makes students responsible for their own learning	52 (50.9 %)	26 (25.5%)	21 (20.6%)	3 (2.9 %)	-	4.2
10	I am sure student centred approach has a significant contribution to scale up the quality of education.	70 (68.6 %)	10 (9.8 %)	5 (4.9 %)	14 (13.7%)	3 (2.9%)	4.2

The above table shows that mathematics teachers about 75 % of them have positive perception towards in implementation of Active Learning in the mathematics classroom. Moreover, the majority of the teachers, about 91.2 % of them, said that

active learning in mathematics classroom enhances students' active participation in learning than passive listening. Apart from that, active learning enhances students understanding level and problem-solving skills. Also, nearly 72.5 % of the teachers agreed that active learning encourages cooperative and independent learning.

Moreover, the mean of this section of the questionnaire is 4.3 which is higher than the average (Hull and Wie, 1986: as cited in Arthur, 2010). It means that teachers were appraised of the assumptions and advantageous of active learning in the mathematics classroom. The teachers were agreed that active learning is initiated in the mathematics classroom when they change the traditional way of teaching.

In the interview, the researcher asked respondents: *What is the main advantage of using active learning in mathematics learning?* The respondents explained that: *Active learning provides learning by doing opportunities to the students, which are a fundamental principle of practical mathematics instruction. The active learning up-raises the students' creativity and independent learning. Moreover, it divides the responsibility of teaching and learning mathematics among students and teachers.*

The researcher again asked that*: Do you believe that active learning in mathematics improves the quality of education? How?* The respondents replied that: *First of all, active learning is the student centred approach, and the quality of education means how much students are able to use acquired knowledge in the required sector. The active participation of the students in learning always improves their understanding level by improving their different levels of visual thinking.*

From the results of the questionnaire and the reaction of respondents to the interview questions, it seems clear that teachers were able to use active learning in the mathematics classroom. They understood that use of active learning in mathematics

learning provides boundless opportunities to the students to cope up with the problems and application of mathematics in required sectors. Moreover, they agreed that active learning improves the students' level of visual thinking, which is higher order thinking skill (Bist, 2017). Thus, Active learning in mathematics supports the higher order thinking skills.

Teachers' Perception of the side effects of Active Learning. There were seven items in this section of the questionnaire. Moreover, this section of the questionnaire consisted the statements related to the possible side effects of active learning while using in the mathematics classroom. Then, the sample group of the teachers of mathematics were asked to respond to these statements. For analysis, the researcher calculated the percentage and mean of each item assigned by the respondents. Moreover, the researcher assumed that Strongly Agree (SA) and Agree (A) as the Agree, Neutral (N), and Strongly Disagree (SD) and Disagree (D) as Disagree. Also, the researcher added the analysis of related interview data with the interpretation of this section of the questionnaire. The mean and percentage of each item are presented in the following Table II:

Table II: Teachers' Perception of the effects of Active Learning

SN	Items	SA	A	N	D	SD	Mean
1	Teaching is the sole responsibility of teachers	25 (24.5 %)	7 (6.9%)	10 (9.8 %)	43 (42.2 %)	15 (14.7 %)	2.7
2	Active learning minimises students and teachers workloads and saves time.	26 (25.5 %)	12 (11.8 %)	7 (6.9 %)	37 (36.3 %)	20 (19.6 %)	2.8
3	Active learning frustrates behaviour of students	4 (3.9 %)	12 (11.8 %)	58 (56.9%)	8 (7.8%)	20 (19.6%)	2.7
4	Active learning is not economical to use instructional aids	41 (40.2 %)	9 (8.8 %)	5 (4.9 %)	27 (26.5 %	20 (19.6 %)	3.2
5	I know that active learning adds workload on teachers	30 (29.4 %)	15 (14.7 %)	27 (26.5%)	8 (7.8 %)	22 (21.6 %)	3.2
6	If there is no lecture method, it is impossible to control the students/the class become noisy while they perform Active learning methodology.	5 (4.9 %)	2 (2 %)	11 (10.8%)	39 (38.2 %)	45 (44.1 %)	1.8
7	It is a tiresome activity for teachers	2 (2 %)	7 (6.9 %)	12 (11.8%)	61 (59.8 %)	20 (19.6 %)	2.1

	to implement active learning in the mathematics classroom.						

According to above table, about 79 % of teachers disagreed with the item seven that indicates activities of active learning are tiresome for mathematics teachers. It means that teachers were willing to use active learning in their mathematics classroom. Moreover, they disagreed that teaching was the responsibility of teachers in which students have no benefits. Item four tries to examine whether active learning is economical or not economical to use instructional aids. A high percentage (49 %) of the respondents agreed, and only 2.5 % replied undecided with this statement. For all items, the mean values do not exceed up to 3.0. This indicates the use of active learning has no side effects on mathematics classroom.

In the interview, the researcher asked the respondents: *Do you feel that active learning is economical concerning time and financial?* The respondents replied that: *The active learning is really time consuming because every student needs to be engaged a variety of activities. However, it is not economical regarding financial. This is because lecture method can be modified concerning the assumption of the active learning.*

The researcher asked the respondents: *Do you agree that students' behaviours are uncontrollable while using active learning?* The respondents reacted that: *Since students are engaged in the different kinds of activities, their behaviours become easy to control because of their concentration on the task completion. However, sometimes, it may appear while the task is not designed correctly.*

The result of this section of the questionnaire and the participant's reply to the interview questions, the main side effect of active learning as it takes more time in the classroom. Because the teachers were obliged to finish the task in allocated time provided by the curriculum. Furthermore, they affirmed that students' behaviours in the classroom comfortably are easily controlled through active learning because it engages students in a range of learning tasks. Apart from that, they understood that in active learning students have ownership of learning in the mathematics classroom. However, the teacher designs the tasks and supports the students as a guide. So that the responsibility of the teaching mathematics becomes the responsibility of both teachers and students equally.

Teachers' use of Active Learning in Mathematics Classroom. To assess the extent to which mathematics teachers have employed active learning in the classroom. The researcher used this section of the questionnaire which contained 14 possible methods of active learning for a single question: How often do you use these Active Learning Methods in the classroom? Then the sample group of the teachers of mathematics were asked to respond to these statements. The answer to this question was recorded regarding Always, Frequently, Not sure, Rarely, and Not at ll. For analysis, the researcher calculated the percentage and mean of each item assigned by the respondents. Also, the researcher added the analysis of related interview data with the interpretation of this section of the questionnaire. These were also substantiated by the classroom observation, but the classroom observation form was analysed separately. The mean and percentage of each item are presented in the following Table III:

Table III: Teachers' use of Active Learning in Mathematics Classroom

SN	**Items** How often do you use these Active Learning Methods in the classroom?	Always	Frequently	Not sure	Rarely	Not at all
1	Lecture/ explanation	27 (26.5 %)	19 (18.6 %)	20 (19.6 %)	15 (14.7 %)	18 (17.6 %)
2	Problem solving method	22 (21.6 %)	25 (24.5 %)	32 (31.4 %	16 (15.7 %)	5 (4.9 %)
3	Role-playing	2 (2 %)	15 (14.7 %)	40 (39.2 %)	35 (34.3 %)	10 (9.8 %)
4	Group Discussion /syndicate	28 (27.4 %)	37 (36.3 %)	5 (4.9 %)	32 (31.4 %)	-
5	Brain storming	10 (9.8 %)	15 (14.7 %)	40 (39.2 %)	15 (14.7 %)	22 (21.6 %)
6	Cooperative learning	19 (18.6 %)	7 (6.9 %)	14 (13.7 %)	31 (30.4 %)	31 (30.4 %)
7	Group work	5 (4.9 %)	43 (42.1 %)	5 (4.9 %)	39 (38.2 %)	10 (9.8 %)
8	Demonstration	7 (6.9 %)	37 (36.3 %)	15 (14.7 %)	30 (29.4 %)	10 (9.8 %)
9	Peer Teaching	1 (0.9 %)	2 (2 %)	14 (13.7 %)	40 (39.2 %)	45 (44.1 %)
10	Student independent work by giving homework/ assignments	45 (44.1 %)	42 (41.2 %)	8 (7.8 %)	7 (6.9 %)	-
11	Inquiry method	5 (4.9%)	20 (19.6 %)	15 (14.7 %)	57 (55.9 %)	5 (4.9 %)
12	Case study	-	-	7 (6.9%)	13 (12.7 %)	82 (80.3%)
13	Discovery method	2 (2 %)	25 (24.5 %)	7 (6.9 %)	38\ (37.2 %)	32 (31.4 %)
14	Problem based learning/project visits	-	2 (2 %)	1 (0.9 %)	15 (14.7 %)	83 (81.4 %)

As presented in the table above, the ordinary way of math teaching is a group discussion and group work. In detail, most of the teachers, about 85 %, in the school practice independent work by giving homework. Majority of the teachers, about 80.3 % of them never used a case study in mathematics learning. Apart from this, problem-based learning or project-based learning is not used all in mathematics learning which is very vital for students to develop self-confidence, deep thinking and problem-solving potential. Moreover, some of them said that they use active learning methods sometimes which imply that most of them are interested in teacher-centred methodology rather than student-centred strategies.

As the interview question, the researcher asked the respondents that: *What is the three conventional methods in mathematics teaching?* The respondents reacted that: *The conventional methods are lecture, demonstration and discussion. These are simple to use and help to complete the course of mathematics in time. The lecture method is not bad for teaching many concepts and ideas in short period.*

The researcher asked that*: Do you know problem-based learning in mathematics or project-based learning in mathematics? How easy is it to use in mathematics?* The participants replied that: *It is supposed that the problem-based learning and project-based learning is best in learning but may not work correctly in the case mathematics. The contents of mathematics are not suitable for problem-based learning in the context of Nepal.*

From the observation, interview and questionnaire result of this section, it reflects that teachers were using lecture method as usual method to introduce new concepts of mathematics and guide to discussion or demonstration. They believed that lecture method was used everywhere in mathematics. The observation of the classes reflects that it was true in all observed classes. The problem-based learning and

project-based learning in mathematics were not used in the mathematics classes at any time. This was because the contents of mathematics were not developed regarding problem-based learning. The participants were not trained in problem-based and project-based learning in mathematics.

In the interview conducted with the teachers, some of the teachers confirmed that applying all the activities in the classroom is difficult. This indicates that the instructors implement the traditional/teacher-fronted approach to teaching. The reasons for not applying the activities may be due to lack of training on active learning and classroom conditions such as large class size and fixed desks.

Affecting factors of the implementation of active learning in the classroom

This section of the questionnaire consisted seven possible factors related to curriculum design, working time in the classroom, dissemination of active learning, use of training in the actual situation, the boundary of the activities in the mathematics classroom. To find out the possible constraints of successful implementation of the active learning in the mathematics learning, the researcher asked the participants to react these statements. The response of these items was recorded regarding three-point Likert's scale with three points: Not serious, Serious, and Most Serious. For analysis, the researcher calculated the percentage of each item assigned by the respondents. Also, the researcher added the analysis of related interview data with the interpretation of this section of the questionnaire. The frequency and percentage of each item are presented in the following Table IV:

Table IV: Factors affecting the implementation of active learning in the classroom.

SN	Factors	Not serious	Serious	Most Serious
1	Bounded time of mathematics curriculum allocated to classroom activities.	7 (6.9 %)	12 (11.8)	83 (81.4%)
2	Students are unwilling to participate in active learning.	45 (44.1 %)	38 (37.2 %)	14 (13.7 %)
3	Teachers are habituated with the traditional approach.	41 (40.2%)	45 (44.1 %)	16 (15.7 %)
4	Large class size	10 (9.8 %)	58 (56.9%)	44 (43.14%)
5	Lack of enough teaching aids for active learning.	7 (6.9 %)	15 (14.7 %)	80 (78.4%)
6	Arrangement of the seating and size of the classroom.	10 (9.8 %)	20 (19.6 %)	72 (70.6 %)
7	Ways of assessment for learning.	35 (34.3%)	16 (15.7 %)	51 (50 %)

The above table shows that factors affecting mathematics teachers' implementation of active learning. Almost all, about 95% of them, teachers responded that shortage of time to use active learning in the mathematics learning is a central affecting factor. Majority of the teachers indicated that large class size of students and availability of proper teaching materials for using active learning is most affecting severe factors of implementing active learning in the classroom. Nearly half, about 60 % of the teachers agreed that habituated form of lecture method hinges seriously on the implementation of active learning in the classroom.

As the interview question, the researcher asked the respondents that: *Does teachers', and students' perception affects the implementation of active learning in mathematics learning?* The respondents replied that: *The students should show their*

willingness to engage in learning activities actively, and they should take ownership in learning. The students need to understand that learning is for themselves. Students are not a willingness to participate peer teaching or other such activities. The teachers need to know the design of the task and system of assessment for learning. Apart from this, the teachers should play the role of enabler by creating opportunities to the students.

From the questionnaire and interview results, different factors hinged upon the implementation of active learning in the mathematics classroom. One of the most influencing factors was the time allocated to math learning in the classroom. One of the hindering factors for the implementation of active learning is a lack of students' interest in active learning and the teachers' perception of the active learning.

Another negatively affecting factor of the implementation of active learning proposed by the teachers is students' belief and perception. According to the instructors' interview, students do not like to be taught by active learning method. Hence, teachers found it difficult to implement active learning. It is also challenging to implement active learning in large classes and in a situation where there is a negative perception the teachers/instructors become reluctant. The most severe factor was the class size, and students access to the range of resources.

Like any other educational issue in the teaching-learning process, it is also possible to think that active learning may have shortcomings or constraints during its implementation in the real classroom conditions. Of these constraints, the researcher has selected five of the most severe possible factors affecting the implementation of active learning in the University. These factors are selected by their frequencies in the responses of the instructors and students. Shortage of time is among these factors. Concerning this problem, the respondents agreed that the timetable was the significant

problem negatively affecting the implementation of active learning. Supporting this fact, Farant (2000) explains the effect of time by stressing that shortage of time limits instructors and students from implementing active learning in the classroom. In this study, the instructors' tendency towards traditional lecture method is blamed as an obstacle to the implementation of active learning by instructors. Concerning this problem, the respondents again agreed that the tendency of instructors and students to the traditional methods of teachers' explanation or lecture was the significant problem negatively influencing the effective implementation of active learning. In this connection, Banteyerga (2008) explains the tendency of teachers toward the traditional lecture method. He stresses that many teachers perceived teaching as a transmission process where the teacher transmits knowledge to students, and the students receive that knowledge based on a detailed official syllabus.

Classroom Observation Protocol

The researcher observed the total 30 classes of 6 different teachers to examine the practices of active learning in the real mathematics classroom using the classroom observation form. The classroom observation form has been divided into three sections: a variety of instructional methods, use of teaching materials, and learning climate, for analysis of the recorded data. Then the researcher noted the thick description of the statement of the observation form. Finally, the researcher generated the essence of the whole observation. The teachers are coded T1, T2, T3, T4, T5 and T6 and their classrooms C1, C2, C3, C4, C5, and C6, respectively.

Instructional methods. Using this section of the observation form, the researcher observed a variety of teaching methods used in the mathematics classroom. There were six items in this section of the observation form. The essence of classroom observation has been recorded as the tick description in the following Table V:

Table V: Use of Instructional methods in the mathematics classroom.

SN	Attributes	Thick Description
1	Students are engaged in the problem solving, and discussion	T1 and T4 engaged students in discussion and problem solving.
2	Teacher divides students into different groups to increase students' participation in learning.	T1 and T6 often divided students into different groups. However, T6 was confused about the assigned task to the students' group.
3	The teacher provides a constructivist learning environment.	T1, T4 and T6 were able to use constructivist learning approach in the mathematics classroom.
4	Teacher treat students as individual	T6 rarely treated students as individual learners.
5	Students are treated as passive recipient	T2 and T3 always used one-way communication in the classroom. In C2 and C3 classroom students were often busy in note-taking process.
6	The teacher is using ill-structured problem for discussion.	None of the classes, it could not be observed that teachers used ill-structured problem for discussion.

The observation table V shows that the use of a variety of teaching methods in the classroom. All observed classes had own difficulties in applying a range of active learning methods, and consequently, they preferred the traditional way of learning in the mathematics classroom.

Teaching Materials. The researcher used this section of the observation form to examine the use of teaching materials to increase students' active participation in the leaning. There were six items in this section of the observation form. The essence of classroom observation has been recorded as the tick description in the following Table VI:

Table VI: Use of teaching materials in the mathematics classroom.

SN	Attributes	Thick Description
1	Teacher introduces new technology in the mathematics learning.	T1 and T3 always used technology in the mathematics classroom. However, T1 used it in one way means of communication.
2	Teacher demonstrates the materials in teaching to each concept of mathematics.	T3, T4 and T6 rarely demonstrated a range of teaching materials, according to the contents of mathematics.
3	Teaching materials are enough to figure out the problems of mathematics.	The teaching materials were used in concept learning but neither participating students in learning nor figure out the problems.
4	Students manipulate the materials for learning concepts and solving the problems.	There were no any materials using students in learning mathematics except C4.
5	Students are asked to participate in online based learning, such as clickers.	None of the teachers asked the students to participate in online based learning. It seemed that there were not any online based mathematics trends in the schools.
6	Students have access to computer lab and math emporium.	Students of C1 and C6 had access to the computer lab but used in math learning. Moreover, there was no facility using mathematics emporium.

Enough access to the teaching materials in the classroom is the primary factor to enhance the whole process of education. However, the observation result indicates there were not enough materials used by the students for demystifying the understanding of mathematics. Moreover, almost all of the observed classes, the teachers did rarely use instructional materials, but students did not use any materials.

In summary, the utilisation of instructional materials in the observed classes was found to be at a minimum level. This might be due to lack of resources.

Creating and monitoring Learning Climate. The researcher used this section of the observation form to examine the how the teacher sets the classroom to provide opportunities to the students to learn mathematics actively. There were six items in this section of the observation form. The essence of classroom observation has been recorded as the tick description in the following Table VII:

Table VII: Creating and monitoring Learning Climate

SN	Attributes	Thick Description
1	The teacher creates a positive learning environment.	T4 and T6 frequently used different learning situation that shifts that had made confusion among the students regarding what to do in next. T1 used only one-way communication system in the whole classroom.
2	The teacher creates a physical environment that engages the students.	T6 tried to make seating plan differently. However, there was not enough space for the students to work correctly. It may be the cause of massive class size.
3	Teachers establish a climate that promotes fairness and respect.	It was rarely seen in the C6; the teacher rarely used to promote fairness and respect among the students and teachers establishing the peaceful learning climate.
4	Teacher manages the instructional time, and foster respect put interactions with among students.	Almost all teachers were unable to manage the time allocated to the classroom activities. However, the T6 rarely tried to inform students about the time which enforced them to escape the activities without completing the tasks.
5	Teacher maximise the structural time	Teachers were unable to maximise the stipulated time to the contents, so that much of the discussion was left to the students to do alone in the home as the home assignment.
6	Students and teacher are interested and enthusiastic.	Students were interested in participating the different kinds of activities in the classroom. However, some teachers were unable to guide them precisely within the short periods of time. Consequently, sometimes students felt tedious to engage in learning activities.

The observation table VII shows that the classroom condition and seating arrangement is not convenient to implement active learning. One major problem observed in the classroom is the layout of the classes. A majority of the observation result indicates that the classroom layout is not arranged to facilitate active learning. The physical environments of the classroom do not reflect the required condition for active learning practices. Due to enough time for practising the contents of mathematics, all observed classes escaped the discussion without deriving a conclusion. However, students were eager to work on active learning climate.

Also, a majority of the activities expected to be practised by the teachers were not observed. For instance, the majority of the observed classes did not show the use of different types of strategies to implement active learning. Moreover, the observation shows that students were not portraying the required behaviour for their own learning. Among nine observed sessions, only 33% of them were observed discussing issues in their groups. The main reason for their poor participation may be the failure of their instructors to use active learning in their respective classes. Sometimes, it is observed that students categorise teachers who initiated them to practice active learning in the class as either not well prepared or incompetent.

Further, the observation indicates that the instructors do not well perform all classroom activities. For example, many instructors do not give group work activities, ask questions or give exercises. Furthermore, almost all of the instructors do not follow up students' participation and activities. According to the observation result, only 33% of the instructors check and give constructive feedback to students' work. In an active learning classroom, however, classroom assessment motivates the learners towards their learning (TESO, 2003; as cited in Teshome, 2012).

Furthermore, the classroom condition and the lack of resources force them to prefer lecture method.

According to constructivism theory of learning, students have ownership in the learning process, and the central point of learning is the learners. In this study, the observation results showed that teacher knew active learning. However, the actual practices were different from their perception. The results of all data adduced that the mathematics teachers used the traditional approach in the classroom due to the various reasons. The teachers were inspired by lecture method in everywhere in the contents, and there were no chances for students to demonstrate their skills and knowledge. The students were almost all time passive or busy in taking notes. The stipulated time of national curriculum of mathematics was the common core problem to inject active learning in the mathematics classroom. The participants agreed that they were up to date active learning through training and other seminars. However, fixed set of furniture in the classroom made obstacle in implementing active learning in the mathematics classroom. Apart from these, the students' perception towards the use of active learning had also influenced the use of the active learning in mathematics. Even though, the teachers had a positive perception toward active learning.

Chapter -V

SUMMARY, FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

This chapter conveys the summary and findings of the study, conclusion and implication of the study based on the analysis and interpretation of data in previous Chapter IV. Then finally the recommendation for future research areas are presented.

Summary and Findings

This is an explanatory sequential mixed method design that has been completed within two subsequent phase. The primary purpose of the study was to explore the mathematics teachers' perceptions and practices of active learning in the mathematics classroom at a basic level. Also, the study has identified factors that hinged on the implementation of active learning in the math classroom, apart from this, the research has identified how often they used active learning in mathematics lessons. The researcher used a descriptive survey design with simple random sampling techniques to complete the study. A hundred and two mathematics teachers from 50 institutional and community schools participated and completed the questionnaire. A qualitative approach complemented this study. In the first phase, the researcher conducted questionnaire on the 102 teachers of mathematics at basic level in Kathmandu Valley. The questionnaire was the form of four parts having 38 items in the total. Then the researcher selected six teachers from 102 teachers of mathematics based on purposive sampling to take the interview and class observation. The researcher observed total 30 lessons (five of each six teachers) while the teachers are teaching in the actual classes using observation checklists (form). The observation form was modified checklist developed by the Central Department of Education (2016). Finally, a semi-structured interview was conducted with six mathematics teachers whose classes were observed by the researcher. The interview questions were

related to each part of the questionnaire and the classroom observation form. The semi-structured interview consisted seven open-ended questions in total. After collecting the data, the researchers analysed the data obtained from questionnaire using descriptive statistics performing SPSS 21.0. The observation data and interview data were analysed based on the thematic approach in which the researcher generated the theme based on the various secondary them. Finally, the researcher made a connection with the results of data based on the relationship to each other, using triangulation. The researcher interpreted the questionnaire results based on the majority of the percentage. The mean of each item was interpreted based on the interpretation criteria provided by Hull and Wie (1986) (as cited in Arthur, 2010).

Based on the analysis and interpretation of the data, there was enough evidence that mathematics teachers had positive perception toward the active learning in the mathematics classroom. However, the implementation of active learning was poor. The following were the main finding of the study:

- The teachers' perception of active learning in mathematics was positive, but implementation was inferior.
- The quality of education was improved if the teacher changes their way of traditional teaching to the new one. It means that Active learning would ensure the quality of education by enhancing the students' level of understanding and building the capacity of problem-solving.
- Active learning created the boundless opportunities to share experiences and encourage friendship among students by encouraging active involvement in the learning rather than passive listening.
- Active learning encouraged independent learning and higher order thinking skills by engaging the students in searching the meaning of knowledge.

- Using active learning in mathematics classroom shared the responsibility of learning between teachers and students equally.
- The most crucial factors that hinged on the implementation of active learning was the time allocated to the mathematics learning in the classroom and unbalanced curriculum of the mathematics for using active learning. Teachers must encourage students to communicate effectively
- Teachers and students perception were also apparent factors that affected the successful implementation of active learning in the mathematics classroom. In fact, the students and teachers' negative perception toward the active learning hindered its implementation in the classroom.
- Lack of training for new techniques of active learning was also obtrusive hindrance factor of using active learning in mathematics classroom successfully.
- Large class size of students and the narrow space in the classroom also hindered the implementation of active learning in mathematics. Consequently, the teachers and students were unable to use a range of activities in the classroom and to manipulate the different kinds of materials in the classroom. Apart from this, the furniture in class was fixed in many schools and that sometimes hindered in group activities.
- The dominant role of Lecture method in mathematics was affecting factor of implementing the active learning in the mathematics classroom. The students and teachers were habituated with the lecture method, and so they followed it autonomously in the classroom.

- Lack of sufficient use of technology in the mathematics classroom and literacy of technology was also made hindrance in the use of active learning in the classroom.

Conclusion

Active learning in the mathematics plays a vital role in promoting the quality education. Active learning ensures the activities to be carried out by the learners. Apart from this, the active learning encourages the students to participate in learning activities in the classroom and outside of the class. Thus, it promotes the independent learning that makes students work with their own knowledge and experiences. The successful implementation of active learning in mathematics classroom shares the responsibility of learning among students and teachers that encourage students to take ownership over the learning process. The active learning demands the full range of tasks to be designed to the students to engage them time to time in the learning activities.

Learning activities in active learning initiated classroom may control the unnecessary behaviours of the students due to their active participation in the classroom. The activities are related to creativity, independent learning, visual thinking, application of mathematics to real-world problems, and searching the meaning of knowledge. Thus, activities in active learning are higher order thinking skills and diverse concerning the real problems.

There is much hindrance to the implementation of active learning in mathematics lessons in Nepal. One of the most prominent factors is the limited time frame for mathematics learning in the classroom. The national curriculum of Nepal allocated the time for classroom activities which is not sufficient for active learning for mathematics. The flexibility of the time for mathematics learning and the

development of curriculum in terms active learning may be a panacea for it. The class size and the available space in the classroom also seen the major problem for initiating the active learning in the mathematics classroom. The class size hinders in classroom activities, and as a consequence, the teacher and students prefer the lecture method in learning. The available space in the class is too small this makes hindrance in using materials and group activities in the classroom.

Thus, it is affirmed that the teachers have positive perception toward the active learning for mathematics learning in the classroom. However, their real practices of active learning in Nepal is so weak due to the various planning and implementing parts of national curriculum of mathematics. The active learning for mathematics generates the quality education and students success in the mathematics because it develops higher order thinking skills of mathematics. Thus, it is necessary to encourage active learning in mathematics from elementary level to higher level in Nepal to improve the national achievement of students in Mathematics.

The implication of the Research

The results of this study may lead valuable insight into the improving the national achievement of the students in mathematics and giving the worth in applying the active learning for mathematics in the classroom. The result of this study has a wide range of application from curriculum designer to the actual practiser of mathematics. Based on the findings and conclusion of the study, the following are the significant implication:

- The national curriculum of mathematics should be amended based on the assumption of active learning. This is because active learning demands flexibility in contents and time for activities.

- The teachers should be encouraged to implement active learning for mathematics through on job training package and other disseminated seminars.
- The technology should be used in mathematics widely. The technology makes easy to implement active learning in mathematics.
- The teachers and students ratio should be reduced regarding the education act, and equipment that is used in class should be portable.
- Lecture method can be restructured while using in the classroom such as think-pair-share.
- Students should be encouraged to participate in a range of group and individual learning activities that are practised in class and out of the classroom.
- There use of different types of online learning system should be encouraged to learn the universal concept of mathematics.
- The assessment for learning should follow the assumption of the active learning. The active learning emphases on performance-based assessment.

Recommendations for the further Study

This study has focused on the teachers' perception and practices of active learning in mathematics classroom based on descriptive survey design including small sample size from the basic level mathematics teachers in Kathmandu Valley. The other researcher may carry out the study based on the considerable sample and the other context or settings to encourage active learning in the mathematics classroom. Based on the experience of this study the researcher has made the following recommendations for the further study:

- It is recommended that further study may be carried out to find out students perception and attitudes toward the active learning in the mathematics classroom.
- It is recommended to explore the articulation of national curriculum regarding active learning for mathematics.
- It is recommended to evaluate the prescribed methods and activities of mathematics learning by the principles of active learning.
- It is recommended to explore the assessment system for active learning for mathematics.
- It is recommended that further study may conduct on evaluating mathematics teachers' professional development regarding the implementation of active learning in the mathematics classroom.

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Appendix A

Questionnaire

For Teachers

Name…… School…… Date……

Dear Teacher,

The purpose of this questionnaire is to collect information to explore the teachers' perception and practices of active learning in the mathematics classroom. Your participation in completing the questionnaire is extremely useful. Please strictly follow up the instructions of each part before responding to the questions. Please choose the answer that best reflects your views on the given alternatives and indicate your answer by checking (√) the column of your best choice

Note:

SA = Strongly Agree, A = Agree, N = Neutral, D = Disagree, and SD = Strongly Disagree.

Part: One

Implementation of active learning

SN	Items	SA	A	N	D	SD
1	The quality of education can be improved if teachers shift their instruction from the lecture methods to Active Learning Methods					
2	Active learning enhances students' level of understanding and involves them in problem solving					

3	Active learning creates the opportunities to share experiences and encourage friendship among students.					
4	Active learning enhances active involvement of students in learning instead of passive listening.					
5	Active learning enhances self-confidence and independent learning of students					
6	Teachers must encourage students to communicate effectively					
7	Active learning offers opportunities for the progress of students' in the application of mathematics.					
8	Active learning prepares students for active participation in the lesson					
9	Active learning makes students responsible for their own learning					
10	I am sure student centred approach has a great contribution to scale up the quality of education.					

Part: Two

Side effects of active learning in mathematics

SN	Items	SA	A	N	D	SD
1	Teaching is the sole responsibility of teachers					
2	Active learning minimizes students and teachers workloads and saves time.					
3	Active learning frustrates behaviour of students					
4	Active learning is not economical to use instructional aids					
5	I know that active learning adds workload on teachers					
6	If there is no lecture method, it is impossible to control the students/the class become noisy while they perform Active learning methodology.					
7	It is a tiresome activity for teachers to implement active learning in the mathematics classroom.					

Part: Three

Use of /Practice of active learning

SN	**Items** How often do you use these Active Learning Methods in the classroom?	Always	Frequently	Not sure	Rarely	Not at all
1	Lecture/ explanation					
2	Problem-solving method					
3	Role-playing					
4	Group Discussion /syndicate					
5	Brainstorming					
6	Cooperative learning					
7	Group work					
8	Demonstration					
9	Peer Teaching					
10	Student independent work by giving homework/ assignments					
11	Inquiry method					
12	Case study					
13	Discovery method					
14	Problem-based learning/project visits					

Part: Four

Affecting factors of implementation of active learning

SN	Factors	Not serious	Serious	Most Serious	Mean
1	Bounded time of mathematics curriculum allocated to classroom activities.				
2	Students are unwilling to participate in active learning.				
3	Teachers are habituated with the traditional approach.				
4	Large class size				
5	Lack of enough teaching aids for active learning.				
6	Arrangement of the seating and size of the classroom.				
7	Ways of assessment for learning.				

Appendix B

CLASSROOM OBSERVATION FORM

Name of teacher: Date of Observation:

Level of Observed Class:

Observed Time:

Name of Observed School:

Part One: **Instructional Methods**

SN	Attributes	Frequency
1	Students are engaging in the problem solving, and discussion	
2	Teacher divides students into different groups to increase students' participation in learning.	
3	Teacher provides a constructivist learning environment.	
4	Teacher treat students as individual	
5	Students are treated as passive recipient	
6	Teacher is using ill structured problem for discussion.	

Part Two**: Teaching Materials**

SN	Attributes	Frequency
1	Teacher introduces new technology in the mathematics learning.	
2	Teacher demonstrates the materials in teaching to the each concept of mathematics.	
3	Teaching materials are enough to figure out the problems of mathematics.	
4	Students manipulate the materials for leaning concepts and solving the problems.	
5	Students are asked to participate in online based learning, such as clickers.	
6	Students have access to computer lab and math emporium.	

Part Three**: Learning Climate**

SN	Attributes	Frequency
1	Teacher creates a positive learning environment.	
2	Teacher creates physical environment that engages the students.	
3	Teachers establish a climate that promotes fairness and respect.	
4	Teacher manages the instructional time and foster respect put interactions with among students.	
5	Teacher maximize the structural time	
6	Students and teacher are interested and enthusiastic.	

Appendix C

Semi-structured Interview Questions

1. What is the main advantage of using active learning in mathematics learning?
2. Do you believe that active learning in mathematics improves the quality of education? How?
3. Do you feel that active learning is economical with respect to time and financial?
4. Do you agree that students' behaviours are uncontrollable while using active learning?
5. What are the three common methods in mathematics teaching?
6. Do you know problem based learning in mathematics or project based learning in mathematics? How easy is it to use in mathematics?
7. Does teachers' and students' perception affects the implementation of active learning in mathematics learning?