

**ACCESSIBILITY AND PRACTICE OF ICT IN TEACHING AND  
LEARNING MATHEMATICS**

**A  
THESIS  
BY**

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### **Letter of Certificate**

This is to certify that Mr. Pradip Dhungel student of academic year 2071/72 with Campus Roll No. 431/071, thesis number 1355, Exam Roll No. 28710310 and Tu. registration number 5-2-37-56-2008 has completed this thesis under the supervision and guidance of Lecturer Mr. Krishna Prasad Adhikari during the period prescribed by the rules and regulations of Tribhuvan University Nepal. This thesis entitled "Accessibility and Practices of ICT in Teaching and Learning Mathematics" has been prepared based on the result of his investigation conducted during the prescribed period under the Department of Education, University Campus, Kirtipur, Tribhuvan University Nepal. I recommend and forward that his thesis be submitted for the evaluation as the partial requirements to award the degree of Master of Education.

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This thesis entitled" Accessibility and Practices of ICT in Teaching and Learning Mathematics "Submitted by Mr. Pradip Dhungel in Partial fulfillment of the requirements for the Master's Degree in Education has been approved.

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**Dedication**

Dedicated

To

My respected parents:

Rajendra Prasad Dhungel and Nirmala Dhungel

### **Declaration**

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

.....

**Pradip Dhungel**

**Researcher**

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.....

Pradip Dhungel



### **Abstract**

The topic of the study is "Accessibility and practices of ICT (Information Communication and Technology) in teaching and learning mathematics." The purpose of this study was to investigate the accessibility of ICT tools and their practices in teaching and learning mathematics. The study adopted descriptive survey design and the information/data was collected by observation checklist, interview and questionnaire.

The sample of the study was 200 students and 24 teachers from twenty secondary schools. The researcher used random sampling procedure to select the sample for finding the accessibility of ICT tools. For the convenience of the researcher Hanumanteshwor Secondary School of Baiteshwor-4 Dolakha was selected for investigating the practices of ICT in teaching and learning mathematics purposively. The data collected by using checklist, were analyzed descriptively according to the percentage score of the data. The responses of the interviewee were analyzed by using qualitative approach.

It was found that most of the schools in Dolakha district had access of ICT tools but only fewer teachers used them due to the lack of pedagogical knowledge. Also some old teacher still believes on traditional way of teaching so they are not modified according to the today's technologies. It was found that the training organize by different institutions are only focus on providing technical knowledge related to ICT but not included pedagogical knowledge related to ICT in mathematics hence the teachers are unable integrate the ICT in teaching and learning mathematics. It was also noticed that maximum students are from the poor background so many of them have no availability of ICT tools at their home.

## Table of Contents

<i>Letter of Certificate</i>	<i>i</i>
<i>Letter of Approval</i>	<i>ii</i>
<i>Recommendations for Acceptance</i>	<i>iii</i>
<i>Copyright</i>	<i>iv</i>
<i>Dedication</i>	<i>v</i>
<i>Declaration</i>	<i>vi</i>
<i>Acknowledgement</i>	<i>vii</i>
<i>Abstract</i>	<i>viii</i>
<i>Table of contents</i>	<i>ix</i>
<i>List of Appendices</i>	<i>xii</i>
<i>List of Tables</i>	<i>xiii</i>
<i>Abbreviations</i>	<i>xiv</i>
<b>Chapters</b>	<b>Page No.</b>
<b>I: INTRODUCTION</b>	<b>1-8</b>
Background of the Study	1
Statement of the Problem	3
Objectives of the Study	4
Research Questions	5
Justification of the Study	5
Delimitations of the Study	6
Operational Definitions of the Key Terms	7
<b>II: REVIEW OF THE LITERATURE</b>	<b>9-21</b>
Thematic Review	9
ICT	9
ICT in Mathematics	11
ICT in Classroom	12
Perceptions towards Use of ICT in Mathematics	14

Empirical Literature	14
Theoretical Review	19
Research Gap	20
Conceptual Framework	21
<b>III: METHODS AND PROCEDURES</b>	<b>22-30</b>
Research Design of the Study	22
Research Site	23
Population and Sample of the Study	23
Data Collection Tools	24
Questionnaire	24
Observation Checklist	24
Interview Schedule	25
Sources of Data	25
Reliability and Validity of the Tools	25
Data Collection Procedure	25
Data Analysis and Interpretation Procedures	26
Ethical Considerations	27
<b>IV: ANALYSIS AND INTERPRETATION</b>	<b>28-56</b>
Accessibility of ICT tool	28
Access at school	29
Access to students	30
Practices of ICT at School	32
Introduction about Case School	32
Information of Teachers	32
Information of Students	33
Practice at Computer Laboratory	33
Practices at Classroom	35

Students practice	40
Skills and Competent	41
Reflections on ICT Integrated Instructions	45
Social interaction	45
Motivation	46
Visualization and Understanding	48
Principal's Perspective	49
Challenges to integrate ICT	51
Economic	51
Manpower	52
Time Management	53
Training	54
Use of Mathematics Software	55
Internet Facility	55
Repairing the Computers	55
<b>V: SUMMARY, FINDINGS, CONCLUSION AND RECOMMENDATIONS</b>	<b>57-60</b>
Summary of the Study	57
Findings of the Study	58
Conclusion	58
Recommendations	60
Recommendations for the Educational Implication	60
Recommendation for Further Studies	60
<b>References</b>	<b>61-64</b>
<b>Appendices</b>	<b>65-74</b>

**List of Appendices**

Appendix A: Checklist for Administration	63
Appendix B: Questionnaire for the students	67
Appendix C: Observation checklist	70
Appendix D: Interview Guide Outline for Teachers	71
Appendix E: Interview Guide Outline for Students	73
Appendix F: Interview Guide outline for Principal	74

**List of Tables**

Table 1: Access of different ICT tools at School	29
Table 2: The availability of computers to students	31
Table 3: Student -Computer Ratio	34
Table 4: Summary of ICT tools used and purpose	36

## Abbreviations

<b>APA</b>	American Psychological Association
<b>B.Ed</b>	Bachelor of Education
<b>BECTA</b>	British Educational Communications and Technology Agency
<b>BECTA</b>	The British Educational Communications and Technology Agency
<b>CD</b>	Compact Disc
<b>CK</b>	Content Knowledge
<b>DVD</b>	Digital Versatile Disc
<b>EFA</b>	Education for All
<b>ICT</b>	Information and Communication Technology
<b>ICT</b>	Information Commutation and Technology
<b>M.Ed</b>	Master of Education
<b>NCTM</b>	National Council of Teachers of Mathematics
<b>OLPC</b>	One Laptop per Child
<b>PDF</b>	Portable Document Format
<b>PK</b>	Pedagogical Knowledge
<b>PTA</b>	Parents Teachers Association
<b>QCA</b>	Qualifications and Curriculum Authority
<b>SMS</b>	Short Message Service
<b>TCK</b>	Technological Content Knowledge
<b>TK</b>	Technological Knowledge
<b>TPK</b>	Technology Pedagogic Knowledge

<b>TU</b>	Tribhuvan University
<b>UNESCO</b>	United Nation Educational, Science and Cultural Organization
<b>UNESCO</b>	United Nations Educational, Scientific and Cultural Organization



## Chapter I

### INTRODUCTION

#### Background of the Study

The world is dynamic. There is a change in every aspects of the human life. Today, humanity can be classified as living in a "machine society" where technological tools are predominant at different levels, interfacing in the day-to-day activity of man. Modern Information and Communication Technology (ICT) is largely responsible for the tremendous changes in our educational sector for the last few decades. The computer which is major component of ICT, is a tool that has singularly and dramatically continued to change the behavior patterns of efficient and effective management of teaching-learning to a very large extent, by determining the modern way of teaching and learning. Yet, up till now, it has been difficult to impart full scale implementation of computer literacy programs at the basic education levels in Nepal. In order for computers to become effective tools for learning, teacher must be able to implement or incorporate them appropriately in their lesson (Wenglinsky, 1998).

ICT has a huge range of functions in education such as; communication, learning tools, administration, information sources and distance learning. Technology comes in many forms including the internet. It can be used in many different ways, one being educational purposes. Throughout history, technology had an effect on education; examples of this are the use of internet, online courses, and the use of technology in class. It's believed that with technology, educators are able to teach students with a higher impact on their education.

The integration of technological tools (computers, calculators, mobile devices, etc.) and in particular how such technological tools are used in the mathematics classroom; to a large extent depend on teachers Thomos & Palmer (2014). It is known

that one of the factors influencing teachers' use of digital technologies is their pedagogical beliefs. For example, teachers' beliefs about the efficacy of computer use in mathematics and their beliefs about the nature of teaching and learning of mathematics Thomos & Palmer(2014).

The potential influence of this kind of beliefs in the way mathematics teachers perceive and adopt the use of technological tools for teaching is an under-researched topic in the field of mathematics education. However, we find that it is an issue that deserves attention, the reason being that it can expand our knowledge about the factors preventing or promoting the incorporation of technological tools in the mathematics classroom.

In recent years, the use of computers as a tool for student learning has become a necessity. The integration of Information and Communications Technology (ICT) in classrooms has been a challenge for the educational systems of all countries which aim to be ready to cope with the needs and the demands of the 21<sup>st</sup> century. Government of Nepal (GON) has proposed a master plan (2013-2017) in the name of “Information Communication and Technology in Education”. It has mentioned that the long term goal of education in Nepal is to provide appropriate knowledge, skills and attitude required to work actively in the development of country and to integrate Nepal into the global community through ensuring equitable excess and quality of education for all and to develop job and market relevant to education. The Ministry of Education (MOE) has considered the use of ICT as essential tool to achieve the goals of education in present context.

MOE has implemented many programs related to ICT in Education. They are: one Laptop per Child (OLPC) pilot project in selected 26 schools of six districts. Under the matching grant schemes (2007 to 2010), DOE provided 2 computers and one printer to 3038 schools (DOE, 2010). Similarly, DOE provided with internet

connectivity to 85 secondary schools conducting distance education programmes.

Besides, some NGOs, trusts, and individuals have been provided computers and other accessories to some schools and basic computers training to teachers.

Different programs related ICT has been implemented in Nepal. The governments of Nepal emphasis integrating technology in teaching and learning mathematics (MOE, 2016).The changes in the education sector have exerted pressure upon the traditional teaching; thereby, causing changes in teaching and learning methods, towards a greater emphasis on student centered learning due to technological developments. This caused an increase in the availability of electronic information sources which has being significant within the teaching and learning. The researcher found ICT is an effective tool for teaching and learning mathematics. So, the researcher is going to investigate the present practices of ICT in teaching and learning mathematics.

### **Statement of the Problem**

Knowledge is expanding day by day so teaching becoming one of the most challenging professions in our society. While learning mathematics, learner expect from facilitator to facilitate meaningful learning rather than just knowledge and skills. In this modern period the use of ICTs in teaching mathematics provides new possibilities in teaching profession. Different research indicates that ICT can change the way of teaching and it is useful in supporting more student-centered approaches to instruction and in developing the higher order skills and promoting collaborative activities.

The use of ICT in teaching requires competencies on part of the teacher and has indeed made the profession more challenging experience and retains knowledge for a longer time. According to the UNDP (2001) statistics, almost 80% of the teachers in developing countries feel that they are not prepared to use the technology. Also

UNESCO (2009), states that the use of ICT promotes the quality in education. That is why, mathematic teachers should be provided with different professional development trainings including use of ICT in the mathematics classroom according to the demand of time. In the context of Nepal the quality of education is poor and one of the approaches to address this problem is to integrating ICT based teaching learning approach to get quality in education.

The integration of information and communication technologies into curriculum is a crucial process in ensuring the quality of education Hue & Jalil (2013). However, the presence of technology alone will not stimulate significant changes in a school. Teachers are an important ingredient in the implementation of ICT in education. Without the involvement of teachers, most students may not take advantage of all the available potential benefits of ICT on their own. Teachers need to actively participate in using ICT. But much report shows a teacher-centered, examination-driven instructional approach emphasizing knowledge of facts and standard methods through drill-and-practice without use of Information and Communications Technology (ICT) are still dominant in Nepalese schools. Therefore, since the tendency of using ICT in teaching and learning strongly depends on the attitudes of the teachers, this study aims to investigate the accessibility and practices of ICT in teaching and learning mathematics.

### **Objectives of the Study**

The following are the objectives of this study

- To find out the availability of ICT tools in teaching and learning mathematics
- To analyze the practices of ICT in teaching and learning mathematics

## **Research Questions**

To fulfill the objectives of this study, the researcher set up the following research questions.

- To what extent the ICT tools are available at schools?
- Which ICT resources (software, instructional tools and materials) do teachers and students use?
- What are the barriers that teachers face during technology usage in the teaching-learning process?
- What are the perceptions of mathematics teachers toward ICT in teaching?
- What are the student's perceptions in relation to the use of ICT in learning?

## **Justification of the Study**

The ministry of education aims at providing necessary skill on information technology to the students as well as using ICT as an important tools to improve classroom delivery, increase access to learning materials and improve effectiveness and efficiency of overall educational governance and management (MOE, 2013). This study is about the classroom teaching and learning and mostly emphasis on the practices of ICT in teaching and learning mathematics. The rationale of my study is to find the current scenario of using ICT in secondary level. I have search the policy, practice, and issues related to the use of ICT in classroom teaching at secondary level. I hope this study will be helpful for the education practitioner for further investigations on similar topic.

The study has the following significance.

- This research would investigate the availability and practices of ICT in teaching and learning mathematics.
- It would be a best platform for introducing additional pedagogy in existing educational system.

- It would help to find the factors affecting ICT in teaching and learning
- It would help to find the present status related to the topics and to make future plan for improvement.
- It would guide the teachers to adopt ICT based teaching in order to provide quality education.
- It would motivate the students to use ICT in their learning process to improve their learning.
- It would support educational administrators and policy makers in choosing the appropriate methods of managing changes associated with ICT use in the educational system.

### **Delimitations of the Study**

The study will be limited in scope and coverage of secondary level at particular school. This study would not make a broad one in scope and coverage due to the limited time constrain on the part of the researcher. The study was delimited under following ways.

- The study was based on accessibility and practices of ICT in teaching and learning mathematics.
- The research concerned with teaching and learning mathematics at grade IX and X.
- The study was delimited to 20 secondary schools of Dolakha district.
- The research conducted on descriptive survey design.
- The interview guideline, observation guideline, and questionnaire were the tools of data collection.
- The research conducted only for four weeks.

## **Operational Definitions of the Key Terms**

**Information Communication and Technology.** The ICT here means applied hardware and software to produce and share learning materials for the students.

**Hardware.** Video input (laptop), video output (monitor or screen), sharing devices (pen drive, mobile)

**Software.** The computer program used to produce and share learning materials.

**Teaching.** It refers to the process by which the teacher undergoes to be able to help the learner to acquire knowledge properly.

**Learning.** Learning refers to the process involved to acquire a knowledge or skill through study, experience and teaching.

**Technology.** Technology refers to all the tools and procedures involved in teaching and learning process. It is also a state of knowledge and development at any given time which includes all tools methods and applied material.

**Government School.** The school which was established from the government conducted under national educational policies and depends upon government.

**Secondary level.** Although the government mentioned grade 9-12 as a secondary level in the new school structure, here secondary level means class 9 and 10.

**ICT Tools.** In this research ICT tools refer computer multimedia, projector, computer, etc. used in teaching and learning at Dolakha district.

**Mathematics software** The software which can be used in teaching and learning mathematics.

**Access of ICT tools.** The availability of different ICT related tools for teachers and learners for teaching and learning process.

**Practice of ICT.** Classroom practice which includes the relationship, interaction and communication between teacher and students for teaching and learning process using ICT tools.

**Conventional Method.** In conventional method of teaching teachers plays active role during teachers rather than children active participation.

**Social Constructivist.** In social constructivism knowledge is the constructed when learners collaborate together. The students plays vital role in the construction of knowledge.



## **Chapter II**

### **REVIEW OF THE LITERATURE**

The review of the literature involves the systematic identifications and analysis of documents related to the study under taken. Review of previous studies helps to conduct the new research in systematic manner by providing the general outline of the research study and avoids unnecessary duplicates. Furthermore, review of literature gives clue about the existing situation of the research topic and also helps to identify and state problems related to the research subject matter.

For this research, I explored different national as well as international research papers published on google scholar and research gate related to my research topic and a thematic review was done. There are not much researches conducted in national level on use of ICT in mathematics teaching and hence only very few national articles were reviewed. Hence, it became one limitation of this study.

#### **Thematic Review**

Thematic is significant part of my research. Thematic review gives recurring ideas about any subject which help us to deliver our objectives. According to my research purpose I searched for existing literatures from different resources which were supportive for my research study. According to my research questions, I went through different related materials for literature review that were use of ICT in classroom, ICT and mathematics, teachers and students perceptions towards use of ICT in mathematics will be discussed on following.

#### **ICT**

According to UNESCO, the term information and communication technologies (ICT) refers to forms of technology that are used to transmit, process, store, create, and display, share or exchange information by electronic means. This wider definition of ICT includes such technologies as radio, television, video, DVD, telephone (both fixed

line and mobile phones), satellite system, and computer and network hardware and software, as well as the equipment and services associated with these technologies, such as videoconferencing, e-mail and blogs Moursund (2005). This emphasizes that using of ICT appropriately help to expand access to education, and help to make teaching and learning effectively. Similarly, According to a United Nations Report (1999), ICTs cover internet service provision, telecommunications equipment and services, information technology equipment and services, media and broadcasting, libraries and documentation centers, commercial information providers, network-based information services, and other related information and communication activities.

According to Adeya (2002).ICT is an electronic means of capturing, processing, storing and disseminating information. National Council of Teachers of Mathematics (NCTM) stresses that technology is essential in teaching and learning mathematics and it influences the mathematics that is taught and enhances students' learning.

Additionally, the Qualifications and Curriculum Authority (QCA) states that: “A sound grasp of ICT is essential in modern society; it gives pupils the skills and understanding needed to use technology effectively, every day and in the world of work ahead. Moreover, a sound grasp of ICT is fundamental to engagement in modern society; it teaches pupils how to find information appropriate to a task and to judge the accuracy and reliability of what they find. It gets pupils questioning and learning things for themselves and provides a gateway to information and experiences from a wide range of people, communities and cultures”.

In the same way several educational organizations have started to develop technology-related standards. In the US the National Council of Teachers of Mathematics (NCTM) considers technology as one of their six principles for school mathematics: “Technology is essential in teaching and learning mathematics; it

influences the mathematics that is taught and enhances students learning” (NCTM, 2000, p. 11).

### **ICT in Mathematics**

Students nowadays live in a world where ICT plays a central role in their daily lives. They enter the classroom not only having encountered rich digital experiences but also being part of a society influenced by new technologies Chrysanthou (2008). In order for them to succeed in our digital culture, they need to be equipped not only with basic but also higher-order skills. The implication for the teaching and learning of mathematics is that there should be a move from emphasizing memorization of facts by learners to a more learner-centered approach where learners enhance on their questioning, elaboration, explanation and other verbalization mechanism, which contribute to the development of problem solving and higher-order thinking skills in mathematics. Ittigson & Zewe ( 2003) cited that technology is essential in teaching and learning mathematics. ICT improves the way mathematics should be taught and enhances student understanding of basic concepts.

Many researchers have carried out studies to evaluate the benefits of using ICT in mathematics. Becta (2003) summarized the key benefits – ICT promotes greater collaboration among students and encourages communication and the sharing of knowledge. ICT gives rapid and accurate feedbacks to students and this contributes towards positive motivation. It also allows them to focus on strategies and interpretations of answers rather than spend time on tedious computational calculations. ICT also supports constructivist pedagogy, wherein students use technology to explore and reach an understanding of mathematical concepts. This approach promotes higher order thinking and better problem solving strategies which are in line with the recommendations forwarded by the National Council of Teachers

of Mathematics (NCTM); students would then use technology to concentrate on problem-solving processes rather than on calculations related to the problems Ittigson & Zewe (2003).

### **ICT in Classroom**

One of the most interesting research fields in mathematics education concerns how to help students come to a proper understanding of mathematics and to change the perception towards mathematics as a harder and boring subject. A great number of teachers and researchers these days try to discover the impact of technology on teaching and learning of mathematics Chrysanthou (2008). There have been several research works regarding ICT and school mathematics and some research works have explored out the role of ICT in teaching and learning mathematics. For example, The British Educational Communications and Technology Agency BECTA (2007) argue that technology ‘improves attainment and helps raise standards, supports school improvement and efficiency, strengthens local authority data management and helps to personalize learning’. The use of ICT, wherever it is possible in the classroom, makes the teaching process more efficient and strengthens knowledge; there are claims that ICT has the potential to enhance cognitive learning, develop problem-solving and higher-level thinking skills and extend physical and mental abilities (Loveless, 1995, cited in Chrysanthou, 2008).

According to Bottle (2005)“, in the first half of the twentieth century, mathematics was viewed as a set of procedures and principles that had to be taught before any potential mathematical understanding could take place”. More recently this narrow view of mathematics has been superseded by a more progressive view of mathematical understanding that describes mathematics as being part of everyday life, wrapped up in culture and social practices". That is mathematics should be an enjoyable for all students and that should be possible by the effective use of ICT.

Teacher should not teach mathematics as only a useful subject but also include student exciting and challenge so for this the use of ICT is a major current area of development in mathematics education. The first wave of technology was the pocket calculator and then microcomputers. Computers were first used in the classroom as aids in numerical calculation; however their most attractive development in the past years has been their potential to create and manipulate graphic images (Fey, 1989).

By using ICT in teaching mathematics difficult problems can be solved easily and very quickly. This saves the teacher's labor and time and the classroom will run interestingly. And also by using ICT in teaching mathematics can help teachers to express clearly what they want to express in the class and students to understand what the teachers have expressed through the demonstration, visualization and experimentation Yadav (2016). Similarly Yadav argues that using ICT in mathematics class makes student more active in the educational process. Particularly, calculators, the audio and visual activities have a great potential to effect presenting the contents of the schools mathematics. It also draws the student attention towards learning. In general students consider mathematics as boring and difficult subjects and if we use ICT instrument in mathematics class it will be helpful to reduce such misconception among such student. This can be possible to some extent due to the properties of computer and media instruments which can easily change the pictures, size, action etc and help attract the students and make concentrate on the matter that teacher is presenting. A prominent trend in computerized instruction has been to make mathematics fun, and indeed, computers seem capable of making almost anything fun. Integrating ICT into teaching and learning is not a new concept. It may be as old as other technologies such as radios or televisions Wang &Woo (2007). However, with the rapid development of emerging technology such as web technology, ICT

integration has increasingly attracted the attention of educators. The integration of information and communication technologies can help teachers and students to improve and develop the quality of education by providing curricular support in difficult subject areas Gulbahar (2008).

### **Perceptions towards Use of ICT in Mathematics**

Many countries in Europe and Asia have determined the importance of ICT and have integrated it into their schools and today it is becoming compulsory to use ICT in teaching and integrate it into subject teaching (Balcon, 2003 as cited in Osamah, 2008). ICT will enhance the way of teaching and it open many new opportunities for both math teachers and students to explore and improve their knowledge and to be creative. Depending upon the philosophical orientation behind the teaching and learning activities, different teachers have different perceptions towards use of ICT. But moreover many teachers accept that by the use of ICT enables students to produce many examples and support their work. Also teachers consider that the use of ICT tools and resources could support teaching and learning activities (Ruthven & Hennessy, 2003). ICT based tools like computer, laptop, and calculator, etc. allowing students to use graphics, images and text together, to demonstrate their understanding of mathematical concepts Jarret (1998). So by using ICT in math Students visualize the problem which helps to understand the problem which helps to change the positive perception towards mathematics.

### **Empirical Literature**

There are different researches that have been carried out in order to investigate the effect of ICT in teaching and learning mathematics. Clarke (2007) carried out a research article “Exploring the use of computer technology in Caribbean continent: view of pre service teachers”. The article presents a qualitative study of five pre-

service secondary school mathematics (PSSM) teachers in an English-speaking Caribbean context. The major goal of this study was to investigate the experiences and perceptions of the PSSM teachers as they explored the use of computer technology (CT) in their mathematics instructional practices, and to identify factors they consider necessary for successful integration of CT in mathematics instruction. These teachers faced similar challenges of developed and other developing countries in their exploration. They suggested that ICT use in secondary schools is needed because of its benefits for both students and teachers and to stimulate interest, motivation and improvement in their students 'performance.

Njagi (2014) did a descriptive research on the topic, "Teacher's Perspective towards Differentiated Instruction Approach in Teaching and learning of mathematics in Kenya." The major goal was to investigate the teacher's perspective towards differentiated instruction in teaching learning mathematics at secondary school in Kenya. The researcher found that teachers have positive predisposition about differentiated instruction and that there is need for extensive training and support so that differentiated instruction can be succeed.

Chong Chee Keyong, Sharaf Horani and Jacob (2005) did a research on "A study on the use of ICT in mathematics Teaching" in Malaysia. This research deployed a survey method to investigate the use of ICT and barriers of integrating ICT into the teaching of mathematics. The survey was carried out during Mathematics in service course conducted by state education Department. The finding concluded that the use of ICT in teaching mathematics can make teaching process more effective as well as enhance the student's capabilities in understanding basic concepts. But there are different obstacles in using them.

Kalinga (2008) did a descriptive research on "Development of an interactive e-learning system for Tanzanian Secondary School" with the main objective to develop

interactive e-learning management system to be used by Tanzanian secondary schools support teaching and learning functions. He concluded that when application of ICT in e-learning that is accessible even in remote and rural secondary schools will improve the performance of schools in such secondary schools as well as raised motivation for teacher and students.

Uribe, Klein and Sullivan (2003) was concerned with identifying the effect of ‘computer- assisted collaborative learning on solving ‘ill-defined problems’.The study addresses the following main question; What is the effect of collaborative learning by using Computer as mediation on student achievement in solving ill-defined problems? The study emerged in emperical studies related to the topic.Firstly,the participants received training on how to use a learning program available on the internet that deals them with the process of solving the problem through four steps associate with solving ill-defined problems.The participants worked with in their pairs as well individuals in order to apply the practical steps of problem solving.The finding revealed that participants who worked in paired were more effective than who worked alone.In addition,the finding revealed significant differences in the amount of time students invested in the the work ,with ‘paired’ students working for longer than individuals.Also the finding indicates that the two experimental groups had positive opinions towards collaborative learning and ICT-based learning.

Rivert, J.R. (2001) studied on “Student achievement in middle school Mathematics Computer Assisted Instruction verses traditional instruction method”, for 6<sup>th</sup> grade classroom were identified two classroom within each of two middle schools. Two class rooms within each of two the middle schools. Two class rooms used Computer Assisted Instruction as the primary means of content delivery involving mathematical concept pertaining to the content area of fractions. Within the same content area, the other two class rooms “primary mode of instruction remained the



lecture and textbook method”. A quasi experiment pretest and posttest design was used. Following a six week study difference score were examined to substantiate the primary hypothesis that the use of Computer Assisted instruction led to increase the student achievement with compare to the traditional instruction methods. Finding: In spite of variability in performance in individual types of fraction operations, the overall improvement scores were significantly greater with ICT assisted instruction techniques than in the traditional classrooms. Further, in spite of the achievement difference between schools, the Computer Assisted classroom performed better than the traditional class-room at each school.

Sapkota (2015), did research on “Effectiveness of information communication technology integrated pedagogy at secondary level” with the aim to find the effectiveness of ICT integrated pedagogy in the existing educational system among students in the experimental and control group of grade IX. Total 46 students of two public secondary schools of Kathmandu district were selected for the study. The conclusion of this research was that ICT integrated pedagogy bring effective result in terms of the achievement of mathematics in comparison to the existing pedagogy as well as students taught by using ICT are more motivated towards mathematics instruction.

Yadav (2016) did a research on ”Opinion towards the practices of e-learning in mathematics” with the aim to find out the existing situation and opinion of students and teachers towards e-learning in relation to improve student’s Mathematical achievements and analyzed/ explain the effect of ICT motivating students to learn Mathematics. The study adopted descriptive survey for 20 schools administrations, 200 students and 100 mathematics teachers in Kathmandu district. The result of the study shows that the schools have sufficient ICT tools suitable existing situation for teaching and learning Mathematics .Both the teachers and students have positive

opinion towards the practices of e-learning in Mathematics .All the teachers and students agreed that the ICT tools are very useful for higher achievement as well as higher study by providing basic concept with motivation.

Barai (2017) did a research on topic Perceptions of students on the use of GeoGebra in geometry teaching. The main objective of his study was to explore the perception, participation and motivation of students on the use of GeoGebra in Geometry teaching at secondary level. He adopted mixed research design at 22 students of Mangal Higher Secondary School, Kirtipur. The major finding of his research were students had positive opinion towards using Geogebra, learning was collaborative, increasing engagement(participation)in classroom activity and geogebra can motivate students for geometry learning.

Shrestha (2015) did a study on “Status of ICT in mathematics teaching/learning. The Objective of the study was to investigate the use of ICT in mathematics teaching and learning. She adopted case study design at Heartland Children’s academy from Kathmandu district. The major finding of her study was that there was neither any plan on the use of educational technology tools in mathematics teaching and neither learning nor inadequate teacher’s training on the use of educational technology. It was also found that there was a lack of relevant educational technology tools for schools.

Lamichhane (2017) did a research entitled Effectiveness of GeoGebra on Students Achievement in Geometry. The purpose of his study was to investigate the effectiveness of GeoGebra software on student’s achievement in parallelogram and circle of geometry at grade X, A pretest and posttest of quasi-experimental research design was used to compare the two groups experimental and control. The result indicates that there was a significant difference between the average achievement score of experimental and control groups on post-test. This finding illustrate that the

students in the experimental group performed better when using GeoGebra than the control group with the traditional teaching method.

### **Theoretical Review**

In the 20<sup>th</sup> and 21<sup>st</sup> century many scholars attempted to define teaching and learning. Teaching methods are the main based on the theory of learning. The most important learning theories are cognitivism, behaviorism and constructivism. These three theories on schools of thoughts are based on learning psychology that has influenced learning theory. The learning theories provide us with conceptual framework for interpretation for the act of learning and show us where to look for the solution to practical problem. They have different perspectives on learning, teaching styles and different approaches to pedagogy and evaluation.

The theoretical perspective of the study was constructivist theory of learning. The constructivist theory has chosen because it builds on prior knowledge. Students use what they already know to make connections to new methods of ICT assisted instructions when students make connection; they learn next technology and relate it to what they have already known. In this study, assisted instruction has been based on constructivist theory of learning because knowledge is actively constructed by students while they make constructions and analyze figures instead of being passively received and accepted. Many educators today believe that constructivists' theory is relatively new theory in education although the tenets of constructivism can be traced back to Socrates.

Some modern day constructivist's theory is Vygotskian theory and Burner's theory. Von Glasersfeld (1987) has stated that constructivist view involves 2 principles; Knowledge is always being created, built up by learners as it is not inertly established and coming to know is a course of action based on the learner's constant adaptations to the experience of the world. Vygotsky developed zone of proximal development which is basically difference between what a child knows and that a child

is taught by others Vygotsky (1978). He believed that child learns through social interactions and by learning to solve problems with others. He called it as “process of scaffolding”.

Burner(1973) stated that learning is process that occurs through social interactions ,and students generate new knowledge by building onto what they already knows The students’ selects information constructs hypothesis, and make a decisions with the aim of integrating new experiences into his existing mental constructs. It is cognitive structure that provides meaning and organization to experiences and allows learners to transcend the boundaries of the information given.

The curriculum should be developed in a spiral manner so that student can build upon what they have already learned. This review of the literature includes the constructivist theory of learning because the student in this study actively built on what they already knew in order to gain an understanding of mathematics. The instructor have also actively engaged in leading the students as they encountered their zone of proximal development (ZPD).The students have also actively engaging in the process of scaffolding .

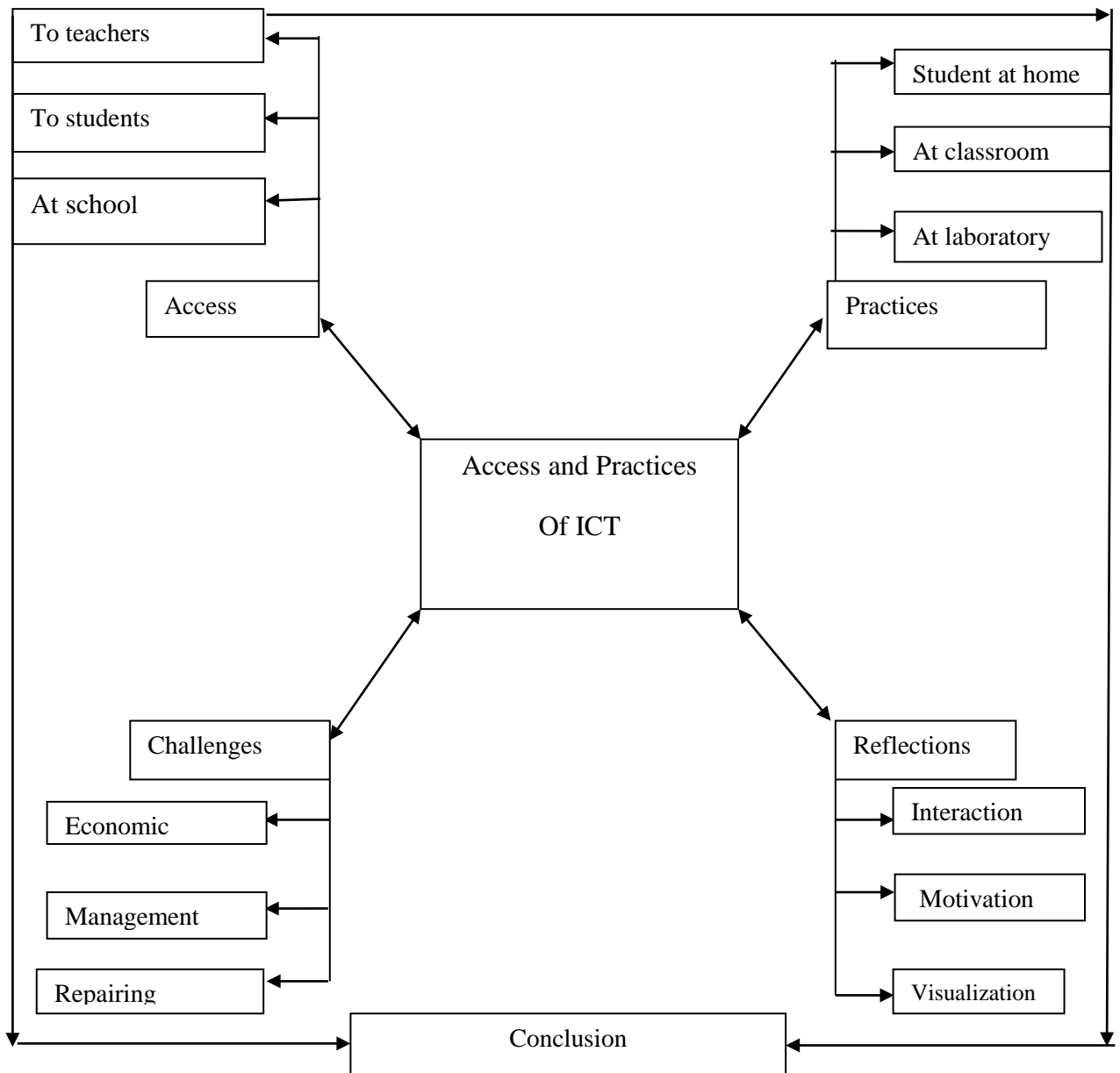
### **Research Gap**

For my research proposal I went through different books, journals and researches which were carried out in relation to use of ICT in mathematics classroom for my literature review and most of them, I found that they have more or less similar type of conclusion that ICT helps of a lot for learning mathematics. By reading different journals and book I found that there are a number of issues about the research and evidence on the effective use of ICT in teaching in schools like historical development of ICT in Nepal? What are the challenges about the use of ICT in context of Nepal? What kind of ICT tools available at school of urban area of Nepal? What are the teachers and students perceptions towards ICT in mathematics teaching and

learning? So to fulfill the research gap I need for research on accessibility and practices of ICT in mathematics teaching and learning.

**Conceptual Framework**

Conceptual framework is an analytical tool with several variations and contexts. It is used to make conceptual distinctions and to organize ideas. It helps to make road map of our research. The conceptual frame work of my study is given with the figure.



### **Chapter III**

#### **METHODS AND PROCEDURES**

Research methodology refers to the philosophical and intellectual framework about the way of data collection to shape the research study in a meaningful way. So, methodology is process to discover new facts and information's about a particular subject matter. It helps to find out the reliable and effective conclusion. In this chapter, I have introduced the research design, research site, population and sample of the study, tools, data collection procedure, and quality standard of this research.

##### **Research Design of the Study**

Research designs are plans and procedures for research that span the decisions from assumptions to detailed methods of data collections and analysis. This plan involves several decisions. So, research design is the way which provides the guideline for the researcher. Educational research can be divided into three broad categories quantitative research, qualitative research and mixed research (Creswell, 2009)

This study on the topic “The accessibility and practices of ICT in teaching and learning mathematics” is based on descriptive survey research design. Survey research is mainly carried out to find out the people’s attitudes, opinion and the specific behaviors on certain issues, phenomena, events and situation. According to (Nunan, 1992, p. 40), “the main purpose of the survey is to obtain a snapshot of conditions, attitudes and events at a single point of time”. Survey research is collection of data attained by asking individuals questions either in person, on paper, by phone or online. Educational survey addresses the educational problems and generalizes its finding on the basis of representative sample of a specified target population. In survey research, the researcher collects the data at a single time and it addresses the large group of population. Thus, sampling is the procedure of selecting of required number of sample

which represents the whole group. It helps the researcher to collect the required number of population. The researcher can use the numerous sampling strategies to accomplish his/her research work. In survey design, data can be collected through questionnaires, observation and interviews etc. Basically, in this study I am going to use questionnaires, interviews schedule, and observation checklist as the main tool to find out the accessibility and practices of ICT in teaching and learning mathematics.

### **Research Site**

The site selection is also very important task in order to find appropriate information. My research conducted to four municipalities of Dolakha district, especially regarding the accessibility of ICT in teaching and learning mathematics. In this research I could not study in the all sites of Dolakha district due to lack many resources. So, that I have limited this study in Jiri municipality, Bhimeshwor municipality, Baiteshwor rural municipality and Gaurishankhar rural municipality.

### **Population and Sample of the Study**

A population may be defined as any identifiable well specified group of individuals. All primary teachers, all housewives etc. are the examples of populations. The selected number of persons or objects is known as sample in others words a sample is any number of persons selected which represent the population according to some rule or plan (Singh, 1997).

In this study, all the students of grade IX and X and all the mathematics teachers of lower secondary and secondary level were considered as population. In order to fulfill the objectives of the research, the researcher had taken some sample which represents the population. The sample of the study was 200 students and 24 teachers from twenty secondary schools. The researcher used random sampling procedure to select the sample for finding the accessibility of ICT tools. For the convenience of the researcher Hanumanteshwor Secondary School of Baiteshwor-4

Dolakha was selected for investigating the practices of ICT in teaching and learning mathematics purposively.

### **Data Collection Tools**

To accomplish the task within time, research tools and techniques would be necessary and appropriate for particular research work. Data collection tools depend on research design. In this study quantitative and qualitative both types of data collection tools were used. In order to collect relevant quantitative and qualitative data, the following data collection tools were used:

#### **Questionnaire**

Questionnaire is also the important tools for data collecting procedure in my study. Two forms of questionnaire were developed. One was for administrators and another was for students. Both open-ended and close ended questions were included in questionnaire according to the requirements. The response from administrators and students through questionnaire in order to find the accessibility of ICT tools for teaching and learning mathematics.

#### **Observation Checklist**

Observation is also one of the powerful tools of primary data collection in which researcher directly visits the field and collects the data from his own careful watching of the events happened or happening in the field. It helps to find out existing situation, environment for ICT instruction and to find out the ICT related materials available in schools (Molia, 2006). For my research I observe the teaching learning process in classroom situation in schools where there is a use of ICT in teaching mathematics. I observe the class of mathematics in order to find out the practices of ICT in teaching and learning for a period of four weeks. I also observe the situation of computer lab. During my observation I take detailed notes on class activities as well as I record video and take photographs of some class activities too.



### **Interview Schedule**

Interview is the process of communication in which the subject or interviewee gives the needed information verbally in face to face situation. An interview can be regarded as change of views between two or more people on topic, enabling verbal, nonverbal, spoken and heard channels to be used. I have used interview schedule for collecting views of interviewee about the practices of ICT in teaching and learning mathematics. The questions of the interview were asked to the interviewee and their responses were analyzed and made conclusions in qualitative approach.

### **Sources of Data**

This study based on survey research design. In order to carry out study, the following data were adopted.

Primary Source and Secondary Source. The primary source based on observation and interview schedule. The secondary source based on articles, journals, previous research related for analysis of data.

### **Reliability and Validity of the Tools**

The research was made on the basis of checklist questionnaire and interview schedule .To ensure the validity of the tools, I have prepared format of all this tools on the basis of review of related literature and verify with subject experts and supervisor. Also I have compared it with the way of preparing checklist, questionnaire, from genuine published books. The reliability of the tools was established using pilot study. Pilot study was conducted at Birendra Secondary School of Dolakha district.

### **Data Collection Procedure**

Data collection is an integral part of research. It is a systematic approach to gathering information from a variety of source. This study has mainly based on the qualitative data obtained from interview schedule. The observation checklist questionnaires are the main tools to collect data. In the beginning of data collection

process I have granted permission from the Head teacher of the schools and subject teacher to conduct research. The students were also informed by their teachers that I came from Tribhuvan University and that I was doing research on accessibility and practices of ICT in teaching and learning mathematics. I have provided the format of questionnaire to the concern teachers, students and administrations and request them to take part in responding. For interview I have directly contact to the concern teachers and students and conduct face to face interview according to the schedule. I have also made record system in cassette player. The themes of the Interview were made according to the objectives and the review of the literature which covered accessibility of ICT tools, teacher's motivation, existing situation, believes, perceptions towards ICT in mathematics teaching and learning.

### **Data Analysis and Interpretation Procedures**

After the collection of data, it is necessary for organization of data so that data can be analyzed systematically. It is the blueprint of the research. Thus it is the next step and the top most step with a view to arrive at the empirical solution of the stated problems. The data collected by using checklist, were analyzed descriptively according to the percentage score of the data. The percentages of the score were calculated by using Microsoft office Excel 2013.

In this study, all interviews were recorded using an audio tape recorder and transcribed. Also, field notes were taken by the researcher to form the basis for the observation study. For the sake of familiarity and precision of the data, the transcripts were checked and re-checked for easy inductive analysis. Finally using the interview as the primary foundation for data collection, teachers, principals and parents comments were analyzed for themes and patterns. The differences and similarities in perspective were traced. Participants' quotes were used as example and evidence of

the findings. Also, tables were used to analyze observational data whereby moments related to the phenomenon under study were captured and described to strengthen the findings. Literature was used to analyze and discuss the themes that emerged. Gaps between the literature and findings were identified.

### **Ethical Considerations**

Ethics is an essential element in any kind of research. It has played important role in conducting and shaping the framework of research. By taking into consideration the ethical codes and conduct, it guided me to orient my research towards high level of ethical ideals. Ethical issues are inextricably interwoven in much of the qualitative or interpretative research (Cohen, Manion, and Morrison, 2007).

The study is carried out with informed consent from the participants. However, before participating interview the objectives and the study procedures were verbally explained to each interviewee individually. Only those giving their consent agreeing to participate in the study were interviewed. Similarly, participants' right to withdraw from the study at the time of interview or afterwards was accepted, and privacy of the respondent was maintained. The participants could withdraw from the study at any time, during or after, without any personal consequences. To ensure confidentiality, codes were used instead of the participants' names during the interview if the matter is very confidential. I have tried to ensure that my research project would be more a fruitful document for all the people like research participants, teachers, the students and the teacher educators where the sanctity of ethical issues is maintained.

## **Chapter-IV**

### **ANALYSIS AND INTERPRETATION**

This chapter deals with the analysis and interpretation of data. According to the set of the objectives of the study, researcher marked the responses of the teachers, students and administrators very carefully and noted the outcomes systematically. On the basis the observed and noted information the analysis and interpretation was carried out.

The information was collected through observation checklist, observation guideline; questionnaire and interview with students, teachers and administrators. The analysis was carried out looking on the accessibility of ICT tools and educators practices of ICT in Mathematics teaching and learning. The researcher had observed the mathematics class of grade IX and X being the participant with mathematics teacher regularly for 30 days during teaching learning activities. Then the classroom observation note was prepared on the basis of classroom observation. The researcher also observed the computer laboratory of the school to obtained the in depth information related to the practice of ICT in teaching and learning mathematics. The others information are obtained by taking the interview with teachers, students and parents. Tables, figures and description of data are used to present the findings.

#### **Accessibility of ICT tool**

The objective of this study is to find out the availability (access) of ICT tools for teaching and learning mathematics. The researcher collects the data through observation checklist and questionnaire in order to examine the accessibility of ICT for teaching and learning process. The result has been presented under the subheading Access at School and Access to Student.

**Access at school**

To accomplish this objective, 10 government schools and 10 private school of Dolakha district where selected for the study. The data are collected through questionnaire for the administrator of the schools. Here the name of ICT tools, sampling score, and their percentage are tabulated below:

**Table 1: Access of different ICT Tools at School**

S.N.	ICT Tools	No .of School	No. of Schools that ICT Tools Exists	Percentage	No. of Schools that ICT Tools does not Exists	Percentage
1.	Desktop Computer	20	20	100	0	0
2.	Overhead projector	20	16	80	4	20
3.	Television(TV)	20	8	40	12	60
4.	VCD/DVD	20	13	65	7	35
5.	Camera	20	5	25	15	75
6.	Radio/Cassette Player	20	13	65	7	35
7.	Photocopier	20	18	90	2	10
8.	Laptops	20	15	75	5	25
9.	Mathematics Software	20	3	15	17	85
10.	Printer	20	19	95	1	5
11.	Scanner	20	14	70	6	30
12.	Telephone	20	14	70	6	30
13.	Fax	20	1	5	19	95
14.	Cable TV network	20	4	20	16	80
15.	Internet	20	16	80	4	20

The result showed that 100% schools have desktop computers which indicate that maximum schools are in access of desktop computers. The 80% percent of the schools have access of overhead projector i.e. more than 50% schools have overhead projector which indicates that maximum schools have access to the overhead projector. It also shows that 40% schools out of total schools exist television i.e. less than 50% schools only exist television which indicates low schools have availability of television as ICT tools. The data showed 65% schools have availability of VCD/DVD player which is more than 50% of the school which indicate that maximum schools are in access of VCD and DVD player .Also the study showed that only 25% schools there exist camera which is below 50% which indicates only less school have availability of camera. The data shows only 15% school has mathematics software and 85% schools doesn't have any existence of mathematics software since below 50% schools only exist mathematical software it indicates that maximum schools are in lack of mathematics software. Among 20 schools 95% schools exist printer and 70% exist scanner that is above 50% which indicates maximum schools have availability of printer and scanner. The study showed 80% schools have availability of internet facilities i.e. above 50% schools have internet facilities which indicates maximum school have internet facilities. The study shows that the majority of the schools exist the ICT tools for teaching and learning mathematics. (Appendix-A)

### **Access to students**

The objective of the study is to find out the access of ICT for teaching and learning. To fulfill the objective 200 learners of a total of 25,220 Mathematics learners studying in Dolakha participated in the study (DOE, 2075).All the students were not from the same cast. Most of them were talking in Nepali language and few of them use their native language as their home language. Since their proficiency in English is low

the instruments had to be translated to their home language to facilitate for the process of getting reliable information.

**Table 2: The Availability of Computers to Students for Learning Process**

<b>Computers Usage in Learning Process</b>	<b>Response</b>	<b>Percentage</b>
Do you have your own computer at home?	Yes	35%
	No	65%
Does your computer connected to internet?	Yes	5 %
	No	95%
Do you use your computer at home for your School work?	Yes	12%
	No	88%
Do you have computer with mathematical Software?	Yes	0%
	No	100%
Does your school have a learning platform or virtual learning environment?	Yes	0%
	No	100%

According to the data only 35% students have their own computer at home which is less than 50% which indicates that maximum students do not have their own computer at home. In regarding to the computer with internet connection only 5% responded that have computer with internet connection which indicates only least student have computer with internet connection. The students who use computer at home for school work are 12 % which is lesser than that those who doesn't use it for school work. This indicates only least students' use the computer for their school work. The study showed that none of the students use any mathematical software and none of the students' response that they have virtual learning environment at their school. Here we can conclude that majorities of the students of Dolakha district have no opportunity to get computers as learning process and only some of them have their

own computers and majority of the students' doesn't use computer for learning mathematics.(Appendix-B)

### **Practices of ICT at School**

The next goal of the study is to analyze the practice of the ICT at School at Dolakha district. To fulfill the rationale of the study I have select Hanumanteshwor Secondary School as the area of the study using purposive sampling since there is maximum availability of the ICT tools at Hanumanteshwor Secondary School

### **Introduction about Case School**

The researcher had selected sample school "Hanumanteshwor Secondary School" which started operating in 2016 BS. It is a public secondary school running from grades 1 to bachelor level. Learners of Hanumanteshwor come mainly from Baiteshwor rural municipality township where the school is situated. There are also a few that come from the nearby villages; namely, Namdu, Kshetraba and Mirge. The surrounding places of the school are cultural diversities. Dahal, Neupane, Karki, Ghatani, Gurung, Tamang, etc. are the local residents of this area. The school has 8 buildings, out of which five are the concrete and the rest are manual assistance of the local people, district development committee and ADB. All the rest are made of mud and stone with the roof of the tin were fully collapsed by the Earthquake and made unusable. They were constructed with the financial and manual assistance of the local people, district development committee and ADB.

### **Information of Teachers**

There are 6 mathematics teachers among 36 teachers at Hanumanteshwor Secondary School. In this research four mathematics teachers among 6 mathematics teacher were participated. In this research the researcher introduced with all the case teachers according to their individual interview and written documents. The



respondent are symbolized by Respondent teacher A, Respondent teacher B, Respondent teacher C, and Respondent teacher D.

### **Information of Students**

Twenty students out of 274 students studying at secondary level of Haanumanteshwor Secondary School participated in this study. All the students were not from the same cast and talking Nepali and their own native language as their home language. Many of these students are not English language speakers because their ability in English is low; the instrument had to be translated to their home language to facilitate the process of getting reliable information. All the students who participated in the study did not have computers at home and their access to computer was school's library, which had a limited no of computers.

### **Practice at Computer Laboratory**

At the time of the investigation there are 30 computers which were placed in three sides of the class. The desks were rectangular and wide enough for placement of digital devices and the benches placed at single sides of the desk were able to accommodate four children. Hanumanteshwor Secondary School's Laboratory had one projector. The teacher can use the white board and overhead projectors which are kept in front of computer laboratory. All the computers in laboratory are operational except two computers. The computers are connected to the internet but the internet service was interrupted on that day. According to the teacher there occurs a maximum problem in internet service which occurs due to the technical problems in the system of service provider.

The computers in the laboratory were connected through server, and used windows 2010 operating system. They had the following application system.

InternetExplorer,GoogleChrome,MozillaExpress,AcrobatReader,OutlookExpress,Casp

erskyAntivirus, Wordpad, Windows Media Player, VLC Media Player and Microsoft office 2010 packages with Microsoft word, Microsoft Access, Microsoft Power Point, Microsoft Outlook and Microsoft Office Publisher. None of the computers have any software of mathematics. Mathematics teachers rarely used computer laboratory for teaching purpose. The table below indicates student-computer student ratio of mathematics for different class.

**Table 3: Student-Computer Ratio for Different Class**

<b>Grade</b>	<b>Total No. of Students</b>	<b>Student-Computer Ratio</b>
7	75	3:1
8	122	4:1
9	164	6:1
10	110	4:1

The table above indicates learner-computer ratio of Mathematics for different classes. It can be concluded from the table that there were not sufficient amount of computers for individual learning. The grade 8 and 9 computer-learner ratio is a bit large which can be barrier towards effective computer technology integration.

The next problem I observed was that a large number of students in most of the class seemed to make it very difficult for teachers to create collaborating activities in the lab. It would however, have still been possible for teachers to create group learning activities in the lab but I observed that they never tried to involved students in collaborative activities. Instead, the teachers habitually walked in the lab, wait for children to get their digital devices ready to start to deliver their lessons. I observed that teacher's 45 minutes classes underlined the difficulty and challenge of managing the digital devices and organizing the large number of students the teachers faced in a small lab room. In most of the lab classes, teachers had to stop the children before task

completion due to lack of time. The teachers complained that the time allocated for lab class was insufficient to provide maximum for the children to practice. One of the experienced teachers explained:

*We have 45 minutes class. It takes five minutes time to go to the lab. It also takes about five minutes time for students to open their devices. We have only about half an hour for teaching in the lab. We have to leave in the middle of the lesson because there's another class too. This is too short time. [Teacher]*

This complaint confirmed what I found in observations that the time for distributing the devices to the students and time assumed for to open the digital device reduced allocated teaching time and the teachers found it difficult to accomplish their planned lessons. Also I have noticed that teachers had to spend more time drawing student's attention towards whiteboard in the front. It was almost difficult for the teachers to divide children into groups and create round table discussion because of the long desks and benches. For example if any students had to leave the seat, many others sitting in the row had to come out to let him/her out. I have noted that that the non-flexible design of furniture and classroom structure was a problem in the lab.

### **Practices at Classroom**

Appendices C and D of observation checklist and teacher's interview guideline mainly focused on the identification of practices computer technology in mathematics teaching and learning. Understanding how teachers use the different ICT tools in the teaching and learning process will portray a broad picture of the usage of ICT in school. In an attempt to answer the question, various dimensions are analyzed. These different aspects of the pedagogical use of ICT in the schools were investigated. While getting responses from the teachers using the interview items coupled with classroom

observations, it is evident that the pedagogic use of the tools in these schools by teachers can be classified into three main types of users. Some of the teachers make use of the available tools in the school during their lessons. Furthermore, some teachers were passively involved in using ICT tools pedagogically in the teaching and the learning process as they use the tools to prepare their lessons, assigning students to search for information and research purposes. Further investigation shows that some of the teachers were non-users of ICT tools as they confirmed they saw no need for using these tools in the teaching and the learning process. I have observed the mathematics class of grade 9 and grade 10. Through the classroom observation I have noticed that there is rare use of ICT in the class room. Only active teachers' use some ICT tools for teaching mathematics.

**Table 4: Summary of ICT tools Used and Purpose**

<b>ICT Tools</b>	<b>Active User</b>	<b>Passive User</b>
Projectors	PowerPoint presentation, display the mathematical figures.	
Laptop and Desktop	Searching information from internet and present in class room, Showing animated videos, Prepare lesson and presentation	Only searching information, finding presentation method through internet. Question typing for examination
Google	Teaching students to find academic materials on the web	Searching information, assigning student to search information
Virtual lab software	Showing practical videos	
Mobile devices	Reference in the classroom.	Searching information.

The above table demonstrated how the active and passive teachers use ICT tools in their classrooms. It was observed that most of them started their lessons by explaining the concepts in their various subjects through the use of the traditional

instructional approach. Since the classrooms were not equipped with ICT tools, the active users took the students to the school multi-media-centre to show them the concept through the use of ICT tools. While some of the teachers made use of the tools provide by the school only to search information in order to find better presentation method and to improve their teaching style. Some others do not use the ICT for any purpose since they trust in conventional way of teaching. This was visible from one teacher's response:

*Using ICT tools facilitates my lessons, for example, a lesson that I used to teach for one hour, now is possible for me to use just 30 minutes. Usually, practical mathematics lesson which involves plotting a graph or drawing tables, a teacher have to come to the classroom and use so much time in drawing and plotting the various points using a whiteboard. What I do in such cases now is that I usually prepare that kind of lessons well ahead of time using Microsoft Excel which is easier, practical and time-saving. (Teacher A)*

Here the active user comments that he used the Microsoft Excel for the content involving plotting different graph and tables. He is satisfied with the use of these tools since it helps him to save his time. During the observation of classroom also I had found that he used the Microsoft Excel for teaching statistics which involves graph plotting, drawing table, calculating mean, etc. which saves his maximum time. The researcher tried to identified which others tools he used for teaching mathematics he mention he actively used the projectors for teaching purpose. He explains;

*As you can see in my bag is my laptop. Basically after doing the standard traditional instructional teaching in the classroom, I take my laptop to the ICT labs, using the projector to project images, I stand behind the class allowing the students to watch video lesson for some*

*time then, and I pause from time to time to explain. I use my phone too. Sometimes I maybe in a class and a student ask a challenging question or in cases where I need to relate what am teaching to real life situation, I may just use my phone to browse through internet related to the lesson I am teaching. (Teacher A)*

The above mentioned view explained how the active teacher practices the ICT in the teaching and learning process. The active teachers use the ICT in different ways. They use different kind of ICT tools like overhead projector mobile phone etc. Mainly it was found that teachers use the overhead projectors to project the different images related to mathematics topics and also they use it to show online videos related to the topic they use to pause and explain the important part of the lesson. It seems that using some technology makes easier for the teachers because they can solve the challenging question ask by the students by browsing through the internet. ICT in teaching and learning is vital issue that must be taken seriously because we have gone past the age where teaching must be done in a classroom, or under a tree. We are now in an age where technology rules, so at least we find some teacher try as much as possible in their schools to incorporate ICT in the teaching and learning process.

In my investigation I found that some of the teachers are passive users of the ICT tools in the teaching and learning process one of them explained:

*Whenever I am at home, there are advanced mathematics related PDF articles that I usually search through the internet and save on my computer. I usually go through these items at home so as to help me improve my mathematical knowledge. So in most of the cases I use my computer back at home to study. I also use it to prepare questions for exams. (Teacher C)*

Here the above view explains how some passive teachers use the ICT in teaching process. It was noticed some teachers use ICT only for searching information and finding the better presentation method and only to improve their mathematical knowledge. They not use the ICT tools like overhead projector or mobile device for visualization in the classroom like active teacher does but they use it for searching better presentation method to improve their teaching. They also use tools to prepare question for examinations. One of the teacher is non user of ICT explain:

*"It has been a good experience so far given that we are using our traditional method of teaching. We live in a country where ICT is still developing, and so I prefer to use the traditional method, the board and marker and it has been fine". (Teacher D)*

From a general point of view, the pedagogic use of ICT in both schools can be considered as very low. Majority of teachers are passive users and only few teachers created innovative classroom practice with ICT in which they gave the students active role in participating in their learning. Some teachers' use ICT as tools for improving their mathematical knowledge. And some teachers admitted not using the ICT tools pedagogically. From their views, they asserted that ICT in education is still a new concept so it will take time for teachers to start making use of the tools in the teaching and learning process. It was evident that pedagogic use of ICT still posits as a difficult challenge among teachers as some of the teachers are more comfortable with the traditional instructional method of teaching.

### **Students practice**

In an interview one of the questions requested learners to explain clearly on what they were actually doing with technological resources in a Mathematics class and at home? Many learners have similar response:

*No, sir we have not used any kind of technical tools at home because we don't have computers at home. Sometimes our teachers asked to search some information related to mathematics but we can't because we don't have access of internet the cyber is very far from our home, so it was impossible for us to used ICT at home. We have just used calculators for calculating. (Students view)*

The above view of students indicated that their usage of technological tools was limited they used only calculators for calculating. The children are coming from different background, some from poor homes where it's hard to for them to have personal computers .Many students can't search the information related to mathematics through google because they don't have access of internet at their home. The last questions of the learner's questionnaire request learners to indicate their frequency on ICT tools usage for different purposes at school. Almost all the learners have similar response:

*We have a computer laboratory at our school but we are rarely used for mathematics lessons because only one mathematics teacher of our school invited us into the computer laboratory for mathematics lesson. Since computers make our learning more interesting and easy but we were unable to use them regularly because school have no proper dedication and management for implementing ICT. Sometimes when*



*there is time we go to the computer laboratory and used computers for solving the problem of our project work at school. (Students view)*

From above response, it became evident that students had a strong positive perception about computer usage in Mathematics teaching and learning even though almost all of them had limited access to computer in their school. The schools have no sufficient plan, dedication and commitment for integrating ICT in teaching and learning Mathematics. Even though the school had a computer laboratory learners are rarely invited into the laboratory for a Mathematics lesson. The laboratory had been in existence for the past fourteen years when data are collected. If no any Mathematics learner was ever invited into the laboratory regularly there are serious problems in relation to technology usage at Hanumanteshwor Secondary School.

### **Skills and Competent**

In this study, teachers' knowledge of the use of ICT as well as their skills and competencies were investigated. Teachers skills and their capability plays vital role in application of ICT in teaching. To identify the teachers' knowledge I have conducted the interview with the case teachers. I wish to understand why some of the teachers are active in using ICT tools in their classrooms while some others not use for teaching purpose. The teachers are asked to explain the kind ICT related training in their subject area, they undertook. From their responses, it was clear that most of the teachers have taken just basic ICT training on how to operate ICT tools during pre-service and in-service training. Also, most of the teachers who are making active use of the tools responded that their skills and competency in the utilization of these tools came as a result of personal efforts they took out of their working hours for their personal development. This is evident from some of their comments:

*Sometimes the seminars related to ICT are organized by the school to train teachers of the subject and update them on syllabus changes.*

*These training are especially for teachers of ICT as a subject. I mean these seminars are being organized to train teachers on basic computer skills. I have no any basic skill before training. I have developed the skill of opening closing a computer and just I can type some English word on computer. But most of the time these trainings do not help teachers in integrating ICT in other subjects like mathematics.*

*(Teacher D)*

From the above view we can conclude some teacher not have necessary skill to integrate ICT in teaching and learning process. They showed their dissatisfaction in training because the training is not sufficient to provide enough pedagogical knowledge. The curriculum also not provides any instruction to use ICT in teaching any content of mathematics. The mathematics education council invites them for teacher training. And they go for different seminars, but they have not yet attended a seminar where they are taught how to integrate ICT in mathematics lessons. Most of the time training provides only some basic computer skills. This conclude

Contrarily, other teachers express their satisfaction on the seminars but emphasize that it helps them in improving their technological knowledge and not knowledge in using the tools to teach their subjects, one of the teachers noted;

*I have received in-service training and also equally not long ago under one governmental organization. After all these trainings, I know some basic knowledge about computer. I also became flexible in browsing and doing research over the net. So I think that training was a key to*

*my current skills on the internet. But the training doesn't suggest any way to implement ICT in mathematics. (Teacher B)*

The teachers admitted that the seminar related to ICT did not help them in their subject areas and they could not make practical use of the tools in the classrooms even when they got the opportunity use them. This indicates that teacher don't have, sufficient knowledge to use ICT tools effectively in their classroom. The one of the teacher of the teachers who is competent noted;

*Most of what I know has been through my personal effort and sometimes I asked help from others who are more ICT competent. I am trying to develop the skill of practicing the ICT with my own motivation because I believe in professional development. (Teacher A)*

Here from the statement given by the competent teacher indicates that what he knows came as a result of his interest in the ICT tools and the ability to work collaboratively with other ICT competent teachers. The teachers' own determination plays vital role in developing their skills and competency in teaching. Here I have noted that many teachers are not trying to develop the skill through their self-motivation that's why they became passive in using ICT tools in teaching.

Teachers' skills and knowledge would not be of much value to the process of integrating ICT in the teaching and learning process without considering students' skills and knowledge in the pedagogic use of ICT. Following from the interview, teachers were asked if their students have the skills to make effective pedagogic use of ICT. The teacher who was more competent in using these tools in the teaching and learning process express the fact that it was impossible at times to use some of the tools as some of the students did not have enough knowledge about the utilization of the tools. The teacher admitted that some of the students are coming from the diverse

background and consequently limit the utilization of the tools in their classrooms. The teacher agreed that:

*The children are coming from different background, some from poor homes where it's hard for them to have personal computers. I have some software on my computer but it is impossible to share with them because most of them cannot utilize it because they understand how it works". Sometimes I asked them to search information related to subject on the internet to complete their project work but it was impossible for them due to lack of their knowledge as well as access to them.(Teacher A)*

Clearly, in this section, it is evident that majority of the teachers admitted that, they did not have enough knowledge to use ICT in their classrooms pedagogically. The seminars and in-service training for teachers in ICT are programmed based and not need based. Many of the teachers claimed not being interested in attending these training. Those teachers who participated showed frustration in training because the in-service training they took did not help them in their subject area. As a result, many admitted not having enough knowledge to integrate ICT in their subject area. From the general view, it was visible from the various responses that these trainings are focusing more on Technological knowledge rather than pedagogic technological knowledge. Some teachers' became active users of ICT due to their personal effort in developing the competency in ICT while others are passive due to lack of self-effort in them. Since maximum students of these school are from the poor background and they don't have enough ICT tools which makes teachers unable to utilize their skill to the student properly.

### **Reflections on ICT Integrated Instructions**

In our research we found only few active teachers apply the ICT in teaching and learning mathematics. Now the researcher try to investigate the reflections of students and teacher s after using the ICT in teaching and learning. For this the research, the researcher collected the qualitative data to fulfill the objective intended. For this, the view of students on ICT embedded is collected through interview schedule (Appendix-D) .Also the interview schedule for the views of teacher has been presented in (Appendix-E).So, the researcher in this research used interview as the tools to understand teachers and student views on using ICT at secondary level in terms of social interaction , visualization and understanding.

**Social interaction.** A social interaction is the way people talk and act with each other .It may include interaction in a team. It includes any relationship between two or more individuals. According to Vygotsky (1978), much important learning by child occurs through social interaction with a skillful tutor .Vygotsky refers to this as cooperative or collective dialogue. For furthermore the researcher had asked students that: *How do you solve any new mathematical problem? Do you discuss with your friend or teacher? The student explained:*

*When there is any new problem at home I get help from my parent.*

*Similarly I discuss with my friend and my teacher at school. We share knowledge, skill, and ideas related to mathematics with friend in group.*

*I can understand mathematics sooner in this way. I also feel great to to guide my friend in the matter known to me.*

From the above view we can conclude that the social interaction plays vital role in learning mathematics. The students were found active in learning mathematics through social interaction. The bright students help the weak student in learning. Most

of the student solves their mathematical problems through different ways of interaction like asking seniors at home, taking part in the interaction with friends by encouraging them in solving problems. Also they learn by interacting with the teachers at school. The student kind learns through social interactions with their family members, peers, and teachers. The researcher furthermore asked to teacher that: *How do you make interactions between the students in computer laboratory? One of the active teachers explains:*

*I take student into the computer laboratory. Student are put into a group and given a topic such as types of pyramid. First of all they individually search about the assigned topic through internet. Each of the students searching the same topic meets together to discuss and collaborate their findings in a group. Students are able to become experts and work corporately in groups to complete task.*

From the view above we can concluded that there are different ways of social interaction between the teachers and students. According to Vygotsky, social interaction plays an important role in learning process and proposed the zone of proximal development (ZPD) where learners construct the new language through socially mediated interaction. Social interactions between peers gave the students opportunities to guide one another and reach level of shared understanding. Here higher ability students play a big role in helping the lower ability students to reach their ZPD. The higher ability students also benefit through new ideas and views of their peers.

**Motivation.** Motivation is the characteristic that pushes individual toward acting, performing actions and achieving. From my study I have found only few teachers in the school are active users of the ICT in the classroom. To get a

comprehensive picture about the general use of ICT, it was necessary find out the impact ICT on teachers. This question was focused on finding impact on teaching and learning with ICT have brought. One of the active teacher replied:

*Many students feel interesting in my classroom. The class is interesting not because I m a good teacher but because I use the technology as well. It can be difficult, for example, to explore how a graph changes when variables change. With ICT they can see how the equation and graph are connected. ICT is crucial to building confidence enjoyment in math. I personally am enjoying it a lot and I do believe that my pupils are enjoying more than me. It has kept us together in the class. The traditional instructional method of teaching permits all knowledge to flow from the teachers to the students, and the students are known as receivers of knowledge. However, the new system with the use of ICT creates a constructivist approach of learning where the students can do research on their own with little or no help from the teacher the teaching and learning process is more interactive between teacher and student, and better learning outcome is realized I confidently would like to say that ICT brings fresh air into the classroom and it makes the students curious and interested towards learning mathematics.*

*(Teacher A)*

From the above view it was concluded that ICT was found as a vital tool that improves the teaching and the learning process .The teachers have positive impact on using ICT. It is important here to note that ICT tools motivate students more involve in the teaching and learning process. According to the constructivist theory teaching through ICT in mathematics helps teacher to construct positive opinion toward mathematics and motivating students for learning. And also from the literature review

Chong Chee Keyongetal (2005) found that the teachers had positive impact in teaching and learning mathematics. Mathematics can make teaching more effective as well as enhance students' capabilities in basic concepts.

**Visualization and Understanding.** Visual learning is a powerful type of learning as it involves different five different skills; observation, recognition, interpretation, perception and self-expression. Providing visualizations gives students the opportunity to see and examine something and then to visually recall and interpret information leading to comprehension and understanding. The question asked to students that .In the manner the researcher asked teacher that: Does ICT helps in visualization and understanding? How? The teacher answered.

*During my school days in secondary level, I thought mathematics is abstract because no picture of the problem and solution are made in the mind so it was difficult for construction knowledge. For example, I have directly memorized the the formulae  $(a+b)^2=a^2+2ab+b^2$  instead of learning it by connecting it with the concept of area. When I became a teacher I realized that it can be visualize using cutting paper as well as using ICT. The visualization helps the students to conceptualize the meaning. So the ICT is useful to visualize the concept of mathematics in meaningful way. (Teacher, A)*

In this regard, I have found ICT is much beneficial to conceptualize mathematical content. Today's modern life cannot imagine without the use of the computer. Educational software with the development of information and Computer technology have created that can be used in educational process. The contextual mathematics teaching is the best way to provide the conceptual understanding of the lessons. For example, teaching the mathematical shape in geometry without the



context may not help for conceptual learning of the student. Instead if the teacher teaches the content by showing the photo of "Doko", with the help of ICT for teaching parallel lines, intersecting line and then the academic mathematics can be contextualized in mathematics learning.

The same question was asked in students .Many of the students have same view point's which is presented below:

*I saw different types of pyramid in the text book. While teacher draw square based pyramid on the white board it seems parallelogram based pyramid. I was confused that the square based has square on base and the height and slant height are different. I make clear my confusion while teachers demonstrate visual of pyramid and 3D drawing pyramid through projector. (Students view)*

From the view of teachers and student it can be concluded that ICT is useful tools to visualize the mathematical figure to develop the meaningful concept in mathematics. It was noticed that the difficult solid figure menstruation and other problems have been easy to learn through ICT. The student states that there is vast difference while studying by using ICT and without ICT. The students can take social interaction, self-motivation for solving the problem of mathematics using ICT which helps the student to reach ZPD of Vygotsky's social constructivism. Here we can found positive reflections towards using ICT because students are active in learning than conventional teaching method.

### **Principal's Perspective**

To begin, considering principal as technological leader, he was asked to define their term what they knew about teaching and learning using ICT. The principal of this school positively commented on the use of ICT in the schools as a facilitating tool in

the concept of teaching and learning process which ensures effective teaching. This was evident from his reaction.

*The concept of teaching and learning with ICT, I think it means enabling the teacher who is the facilitator of learning use ICT tools such as; computer, overhead projectors, scanners, and any sound equipment, digital camera, and video camera. In another hand, learners can also use the tools to facilitate the learning process. So it is a two-way process. For students to have an education in a secondary school, we need to guide stakeholders and provide support in order catalyst the process of knowledge acquisition which nowadays can be effectively done through the use of ICT. The ICT can act as a facilitating engine for teachers to get information which can be impacted to the students; as a result, ICT is a proper tool for academics. (Principal's view)*

Upon defining the concept of teaching and learning with ICT, the principal generally agreed on the fact that the teaching and learning environment is characterized by two key players who are the teachers and students. He had dedicated to enhance ICT practice in the school. In an attempt to this, he supervised in-service ICT training in the schools; motivated teachers to attend in-service training related to ICT. The analysis clearly shows that school principals in the 21st-century profession is becoming more and more sophisticated with the introductions of ICT in schools. From a technological leader perspective, the principals saw ICT as a tool that can transform the teaching and the learning process.

### **Challenges to integrate ICT**

After investigation of Hanumanteshwor Secondary School researcher found that there is rare used of ICT in teaching and learning process? Teachers were not utilizing the internet and others facilities for teaching process well. School computer laboratory is used very minimally and in most instances, it is used for other purposes rather than for teaching and learning mathematics. Teachers and students both have positive impact on the use of educational technology in mathematics teaching and learning even though the technological resources are not utilized well. Thus students did not know how to use computer technology in mathematics learning. Therefore after discussion with teacher, the researcher identified various problems related to the practice of ICT in mathematics teaching and learning through the interview with teachers, students and principal of the schools. They are critically described below.

#### **Economic**

It says that school inputs, teacher inputs, student inputs and family inputs along with the national, community and school contexts act through the school process to determine student outcomes. Using ICT technologies is comparatively more expensive in itself.

So, on the question *“How many students have computer at home? Does you have computer or not?”* Teacher replied *“Most of the student's does not have computers at home but we have”*.

This is the fact that the study of mathematics using computers at home is not possible for them. Since the teachers have easy access to use computers at home and school, they are not motivated to use for teaching and learning Mathematics. When researcher asked, *“Why do you not use the ICT for teaching the mathematics regularly?”* Teacher replied *“Salary and facilities provided by school is not enough for us. We are the sons of farmer. We have to engage in agriculture for earning*

*money." That's why they spent most of the time working in field for earning money. They don't have time to prepare lessons to use ICT in teaching learning mathematics". (Teacher's view)*

Most of the teachers of the schools in rural area are farmers. The facilities provided by school are not enough for them. To fulfill their economic necessities they have to engage in agriculture. Since they utilize their extra time for other jobs like farming they cannot manage the time to prepare lessons to use ICT in teaching mathematics. From above view it can be concluded that the economic problem is one of the major challenges in implementation of ICT in teaching and learning Mathematics.

### **Manpower**

Another important category of school inputs is teacher inputs. Lack of adequate number of teachers is serious problem. Neither the school administration nor SMC is responsible for management of skillful teacher. There is only one teacher who has achieved training for ICT integration. On the question, *"Do you have knowledge to use ICT in teaching and learning Mathematics?"* *Teacher replied "We don't have enough knowledge, skill and idea to relate the mathematics contents with ICT. This is something like affording a fish instead of teaching how to do fishing". (Teacher's view)*

The teachers admitted that they have no pedagogical skill to use ICT in teaching and they could not make practical use of the tools in the classrooms even when they got the opportunity use them. From their views, they asserted that ICT in education is still a new concept so it will take time for teachers to start making use of the tools in the teaching and learning process. The implementation of ICT in teaching mathematics is possible only if the teachers have enough pedagogical knowledge to utilize them in co-operative learning. Hence we have concluded that lack of manpower is one of the issues to implement ICT in teaching.

### **Time Management**

It seems problem in management of time from all sides, teachers, students' administration, SMC and other concerned bodies. One of the repeated responses made by the teachers concerning the use of ICT was linked to the access of the ICT tools and ICT infrastructure in the schools. Teachers complained of limited access to ICT tools in the schools due to the school timetable structure. All the teachers addressed the lack of time to effectively use ICT in the classroom. The time per period, the no of students and the teachers, capabilities are quite imbalanced because of which mathematics teachers could not use their computer skill in teaching. On the question, "How much time is provided for mathematics classes to use computer laboratory?" teacher replied, *"We are unable to manage the time to go computer laboratory to search information and if we want some time, the computer lab is usually busy"*. (Teacher's view)

Since the computer is an obligatory subject from primary level to lower secondary level the labs are seems busy maximum time. It seems difficult for mathematics teacher to use computer lab for teaching their subject. The other teacher also expressed his experience on managing the time. He replied: *"We have 45 minutes class. It takes five minutes time to go to the lab. It also takes about five minutes time for students to open their devices. We have only about half an hour for teaching in the lab. We have to leave in the middle of the lesson because there's another class too. This is too short time"*. (Teacher)

It was noticed that teacher's 45 minutes classes underlined the difficulty and challenge of managing the digital devices and organizing the large number of students the teachers faced in a small lab room. In most of the lab classes, teachers had to stop the children before task completion due to lack of time. The teachers complained that the time allocated for lab class was insufficient to provide maximum for the children

to practice. Hence time management is also one of the major challenges to implement ICT in teaching and learning mathematics.

### **Training**

Apart from the students themselves, teachers and school leadership are the main agents for the improvement of the school. One of the preliminary steps in implementing any ICT- based approach is teacher preparation. Unless the teachers are fully comfortable with new approach to teaching, providing students with computers and educational content alone will have limited impact on teaching and learning process. That's why training related to the specific subject with appropriate use must be essential for teacher. Base on this situation researcher asked. “Are you trained how to use ICT in your subject? Some teachers replied, *"We are not trained to use ICT in teaching mathematics. First of all, our programme and curriculum do not allow us to use these tools. We sometimes go for seminars, but I have not yet attended a seminar where we are taught how to integrate ICT in mathematics lessons. Most of the conference I have attended, teachers were just trained on some basic computer skills"*.

(Teacher's view)

The teachers admitted that the seminar related to ICT did not help them in their subject areas and so they could not make practical use of the tools in the classrooms even when they got the opportunity use them. This indicates that teacher don't have, sufficient knowledge to use ICT tools effectively in their classroom. Few of the teachers considered active users, had good *Technological Knowledge (TK)* and *Technological Content Knowledge (TCK)*. This alone was not enough to guarantee effective integration of ICT in the teaching and the learning process

### **Use of Mathematics Software**

It has been observed that there is not appropriate mathematics software available for teaching and learning mathematics in the computer. None of the computer in the computer laboratory has any mathematics software. Although one of the mathematics teachers has some mathematics software like Geometer's Sketchpad, Geogebra etc. which is only used by him for his personal purpose. Neither their SMC nor school administration team has shown effort to facilitates the initialization of mathematics software .So the unavailability of specific mathematics software is also one of the challenges for implementation of ICT in teaching mathematics.

### **Internet Facility**

While computers are essential tools for delivering ICT-based education, the full power of ICT in education can only be realized when these tools are connected to wider network that allows users to access information from across the globe and share their knowledge with others.

The cost of the internet is high and it is difficult for SMC to afford the cost. It was noticed that schools are not able to connect to World Wide Web (WWW) due to high cost involved in connectivity. The higher cost of high bandwidth internet facility has tempted schools to go for low bandwidth and lower cost leading to troubles connecting to internet as well as slow buffering. Also lack of skilled manpower in the technical sector for the repairing and maintenance of internet connection has played a role in slow connectivity according to teachers.

### **Repairing the Computers**

It was found that there is no enough number of computers for teaching at secondary level. No enough projectors for the computer presentation in the classroom. Computers are still very expensive and despite spirited efforts by the Nepal

government, NGO cooperate organizations and an individual's to donate computers to the school as possible but it is not sufficient.

It was noticed that most of the computers in school were not been adequately equipped .It is very common to see a school library full of broken own computers some repairable and some are not repairable computer. It was found that repairable computers are also not been repaired due to the lack of trained technicians to repair it.



## **Chapter-V**

### **SUMMARY, FINDINGS, CONCLUSION, RECOMMENDATIONS**

This chapter deals with the whole summary of the study, states the finding of the study, gives concluding paragraph of the results of the study and suggests possible directions for future studies as recommendations. After going through the analysis and interpretation of the collected data an attempt has been made for summary and conclusion. In the similar way, the recommendations are intended for further study. The purpose of this chapter is to present the result of the study precisely.

#### **Summary of the Study**

The study was undertaken to examine the accessibility and practices of ICT in teaching and learning mathematics. Especially the objectives of this study are:

- To find out the access of ICT in teaching and learning mathematics
- To analyze the practice of ICT in teaching and learning mathematics

This study used a descriptive survey research design, which is procedure for collecting information by interviewing or administering a questionnaire for a sample of individuals. The population of the study was consisted of all the secondary level students of public and private school of Dolakha district on the academic year 2075. Total 200 students and 20 administrators are selected from twenty schools using random sampling for finding the accessibility of ICT in teaching and learning mathematics. For analyzing the practice of ICT in teaching and learning mathematics Hanumanteshwor Secondary School, four teachers of the case school and 10 students are selected purposively.

To achieve the first objectives of the study, the data are collected through checklist for administrators and students. They are analyzed by using percentage of the

score. In order to achieve second objectives of the study the data are collected through observation and interview schedule are analyzed based on qualitative approach.

### **Findings of the Study**

On the basis of analysis of data the following findings are given:

- It is found most of the schools in Dolakha district have access of ICT tools.
- There is rare used of ICT tools for teaching mathematics.
- Only fewer teachers use the ICT tools actively in the class.
- Some schools have ICT materials but due to lack of teacher's training they could not use them in teaching.
- The training organizes by the Mathematics Educational Council have not included the program related to the integration of ICT in mathematics.
- The seminar related to ICT provides basic knowledge on computer but not provide the pedagogical knowledge to use in mathematics teaching.
- Some active teachers use ICT for presentation and to provide visualization.
- Some teachers only use ICT to search information and finding out better presentation method.
- Some old teacher still believes on traditional way of teaching so they are not modified according to the today's technologies.
- Maximum teachers have no self-effort to develop their skill and competency in teaching.
- It is found maximum students have no access of ICT tools.

### **Conclusion**

This study tries to examine the pedagogic use of ICT in a school system involving relevant teachers' students and administrators who guide and controls the teaching and the learning process. It is evident from previous chapters in this study

that when the right framework are put in place focusing on integrating ICT in the curriculum, then the significant impact is felt in the teaching and learning process. ICT integration does not only influence the way teachers teach but also what they teach. From this study, it is clear that ICT itself cannot be presented as an added value, but it is needed to build a connection between pedagogy and the content. ICT is required to flexibly fit different subjects of the curriculum with the pedagogy to assist the teaching and learning process. According to the finding from this study, it can be concluded that the pedagogic use of ICT has been influence by the availability of the tool, physical class structure, the students and teachers attitude, teacher's own knowledge, class cultural diversity, student socio-economic conditions, school leadership style, community perception about ICT etc.

Beginning with the teaching process, firstly when teachers have the interest in continuous professional development, they are likely to start seeing ICT as a better tool to enhance their pedagogic practices. Secondly, after seeing the importance of changing their pedagogic practices, it is evident that they will start learning how to use ICT tools. In the course of learning, I suggest this is one of the most important stages of teacher development because if they are not guided, they may focus more on the technological knowledge and content knowledge, resulting in limited influence of using ICT in their classroom. Throughout this study, this was evident, and it is quite clear to say that equipping teachers with technological knowledge seem to be the only focus in most of the training programmes. I believe if these programmes are transformed in such a way that teachers could be taught through ICT it will radically change their attitude, belief and pedagogical practices. When these training are properly organized with focus on exposing teachers to ICT in all domain of their subject area, it will be easier for them to use the tools in their classrooms effectively.

## **Recommendations**

From the findings of the present study the researcher suggest the following recommendations:

### **Recommendations for the Educational Implication**

- Mathematics teacher should be encouraged to use and adopt educational technology together with teaching method.
- The mathematics teacher should be encouraged to emphasize the group discussion and student's centered method instead of regular lecture method
- Ministry of education and NCED should encourage the teacher through training to improve the existing mug and jug method by using Information, communication and technology. For these NCED and MOE should organize the various training programmes, workshops conferences etc.
- Every teacher should be capable to introduce the technology as a method and media in their teaching and learning activities. For these teachers' personal effort as well as effort by the NCED is required. Besides, there needs a change in teacher education curriculum to incorporate ICT tools based pedagogies in academic programmes.
- MOE should be able to introduce the new pedagogies which are based on educational technology. So that such pedagogy could be mild stone to bring the withdraw children to main stream of education.

### **Recommendation for Further Studies**

This is a case study which is limited in its generality. However, this study begins to give teacher trainers and educators some insight into how teachers are able to transfer their pedagogical ICT skills and knowledge to their teaching practicum in their classrooms.

Suggestions for future research in this area include:

- Extending the research to a larger sample for more realistic and statistically reliable data
- Including more classroom observations and interviews to better understand how these teachers apply ICT with classroom practice
- Talk to cooperating guardians of the schools to gain a better understanding of the situation in schools.
- Study the students background by observing their home environment
- Study the existence of relationship between ICT tools usage and ICT policy
- To analyze effective training model for pedagogical implementation of ICT

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8. At school, on a weekly basis, How much time do you use computer for learning process?

<b>Time</b>	<b>English Language</b>	<b>Science</b>	<b>Mathematics</b>	<b>Nepali</b>
Never use				
1 hour/week				
2 hour/week				
3 hour/week				
More than 3 hour/week				

9. Do you have used any other sources of ICT for learning? Please mention below

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.....

**Appendix- C**

**Observation Checklist**

Observation checklist for classroom interaction

1. Physical Feature
  - a. Computer lab
  - b. Lighting in the lab
  - c. Computer position in the lab
  - d. Learners sitting arrangements
  - e. No of operational comuters
  - f. Number of computers connected to printer and internet
  - g. Name of applicable system available in computer
  - h. Name of Mathematical software program available
  - i. Name of others technologies available in computer laboratory
2. Use of ICT in class

Excellent use    Acceptable use    not use

- a. Media and technology that is specific to the content area
- b. Include integrated teaching and learning experiences using internet and other technologies
- c. Provided opportunities for learners to use ICT as a source of learning
- d. Integrate the ICT to simulate real word problem
- e. Application of ICT for content and purpose

Content

Purpose

1.....

.....

2.....

.....

## **Appendix-D**

### **Interview Guide Outline for Teachers**

Dear Respondent,

I am Pradip Dhungel, student from Tribhuvan University Campus Kirtipur, Kathmandu, carrying out a research on *“The accessibility and Practices of Information Technology in Teaching and Learning Mathematics”* I shall be grateful for your kind assistance and participation in making this task a success. This study is strictly for academic purpose and will be treated with high degree of privacy.

#### **Exploring ICT Usage in Teaching**

- Can you describe in detail how you plan and select ICT tools to use in teaching? Which criteria do you use in selecting these tools?
- Do these ICT resources ensure effective teaching? Please can you elaborate more with an example?
- What problems do you face in using these ICT tools in your classroom?
- What do you suggest can be changed in this school so that teachers can effectively use ICT in delivering their lessons?
- Do your students have the skills to make effective use of ICT?

#### **Teacher’s ICT Skills/Competency**

- Have you undergone any professional ICT training before? If yes, can you describe the kind of training?
- Do you have sufficient knowledge to use ICT equipment and software effectively and efficiently?
- Is there any guideline or policy for teachers to use ICT in this school?
- Do you have a computer at home? How often do you use them and for what purpose?

- Does it make you a more knowledgeable teacher?
- Does it make you teaching more efficient?

### **Pedagogic Model**

- Do you see the teaching of ICT as a subject or can it be effectively integrated in the teaching of other subjects? Can you give a reason for your answer?
- As a teacher, can you describe how one can use ICT as a pedagogic tool in teaching? Please illustrate with an example.

### **Impact of ICT Usage**

- From your experience as a teacher, has the use of ICT changed the way you teach your students? Can you explain the various outcomes of these changes?
- What importance do you place on ICT in the curriculum and in teaching?
- Is there any difference when using ICT in teaching as oppose to normal teaching without ICT? If yes, why do you say so?
- Does visualization of image through ICT helps in developing concept in mathematics? How?



## Appendix-E

### Interview Guide Outline for Students

Dear Students,

I am Pradip Dhungel, student from Tribhuvan University Campus Kirtipur, Kathmandu, carrying out a research on *“The accessibility and Practices of Information Technology in Teaching and Learning Mathematics”* I shall be grateful for your kind assistance and participation in making this task a success. This study is strictly for academic purpose and will be treated with high degree of privacy.

- Do you have computer at your home?
- Do you use your computer at home for your schoolwork?
- Does your School have computer laboratory?
- Do you go to the computer laboratory?
- Does your teacher invite you to the computer laboratory for mathematics lesson?
- Do you use any technology for learning mathematics?
- How long have you been using the computer and its application for learning process?
- Tell me any activity you prefer with ICT?
- Can you use Internet for searching information?
- Does you teacher explore visual of any mathematical figure? How does it helpful?

## **Appendix-F**

### **Interview Guide Outline for Principal**

Dear Sir,

I am Pradip Dhungel, student from Tribhuvan University Campus Kirtipur, Kathmandu, carrying out a research on *“The accessibility and Practices of Information Technology in Teaching and Learning Mathematics”* I shall be grateful for your kind assistance and participation in making this task a success. This study is strictly for academic purpose and will be treated with high degree of privacy.

- According to your experience as a principal, how can you define the concept of teaching and learning with ICT?
- Are there any programmes or projects set by the school administration to integrate ICT into the various subjects or curriculum individually? If yes, please can you explain that in detail?
- Has there been any training, workshop or seminar for the teachers since you took over as principal of the school?
- Do you think ICT is used properly as a pedagogic tool in the school? Can you explain that with an example?
- How can you describe the school curriculum with regards to pedagogy and ICT?