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**AVAILABILITY OF ICT TOOLS IN MATHEMATICS CLASSROOM: A
CASE STUDY**

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**A
THESIS
BY
RAJAN BISHWOKARMA**

**A THESIS PARTIAL FULFILLMENT OF THE REQUIREMENT
FOR THE DEGREE OF MASTER OF EDUCATION**

AVAILABILITY OF ICT TOOLS IN MATHEMATICS CLASSROOM: A CASE STUDY

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UNIVERSITY CAMPUS, KIRTIPUR
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2023



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Letter of Certificate

This is to certify **Mr. Rajan Bishwokarma**, a student of the academic year **2018/2019** AD with thesis number **1772**, Exam Roll No. **7428301**, Campus Roll No. **112**, and T. U Regd. No. **9-2-375-98-2014** has completed his thesis under the supervision and guidance of Mr. Krishna Prasad Bhatt during the prescribed by the rules and regulations of T.U Nepal. The thesis entitled “**Availability of ICT Tools In Mathematics Classroom: A Case Study**” embodies the result of his investigation conducted from **2021 to 2022** at the Department of Mathematics Education, University Campus, Tribhuvan University, Kirtipur, and Kathmandu. I recommend and forward that his thesis is submitted for evaluation to award the Degree of Master of Education.

Date: 23 January, 2023

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By

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Entitled

“Availability of ICT Tools in Mathematics Classroom: A Case Study”

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

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Recommendation for Acceptance

This is to certify that **Mr. Rajan Bishwokarma** has completed his M.Ed. thesis entitled “**Availability of ICT Tools in Mathematics Classroom: A Case Study**” under my supervision during the period prescribed by the rules and regulations of Tribhuvan University Kirtipur, Kathmandu, Nepal. I recommend and forward his thesis to the Department of Mathematics Education to organize the final viva-voce.

Date: 23 January, 2023

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Mr. Krishna Prashad Bhatt

(Supervisor)

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Dedication

*This thesis is dedicated to my father **Mr. Surya Biswokarma,***

*and my mother **Mrs. Muma Kumari Bishwokarma,***

Whose love, support, and encouragement have enriched my soul and inspired me to

Complete this research.

Declaration

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

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Rajan Bishwokarma

Abstract

This study focuses on the " **Availability of ICT Tools in Mathematics Classroom: A Case Study**". The main objectives of this study were to find out the status of the use of ICT in Mathematics classes at Dhading District and to find out the opportunities and challenges to practice ICT at secondary level mathematics teachers and students. This study was based on qualitative Research design.

This study was conducted with a sample of one school from the public selected by purposive sampling. The Researcher has selected one head teacher, two mathematics teachers and four students of Shree Palpa samari bhanjyang School. Researcher used direct interviews with students, the head teacher, and the math teacher. Researcher observed classroom two times on different days during teaching-learning activities. The collected information from teachers and students was analyzed with the help of the theoretical and conceptual framework developed by the researcher.

The finding of the study shows the development of innovative technologies for teaching learning activities, the government schools of Nepal were trying to implement ICT integration into schools. The school has its computer lab and other ICT infrastructures available at school. The available tools and devices were not sufficient because of excessive number of student. Mathematics teachers were using technologies for teaching mathematics interactively.

This study shows that several challenges and opportunities to utility ICT in mathematics. ICT integration in Mathematics-education has a positive impact on both the teaching and learning process. The study was conducted to determine the impediments to the integration of ICT in Mathematics. There are some barriers to integrating ICT in teaching and learning mathematics in various branches of mathematics.

Major education implications of the study are school administration should give more concentration to build ICT infrastructures and motivate teachers to integrate technologies in their classroom activities. Government schools should try to coordinate with different governmental non-governmental organizations to develop their ICTs capacity in school. Mathematics teachers also should improve their teaching-learning practice emphasized on group discussion and child-friendly teaching-learning instead of lecture methods. Students should know about there are various opportunities to learn besides the classroom activities.

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Chapter I

INTRODUCTION

Background of the Study

Mastery of mathematics is a key literacy component that influences children's success in education and future society (Engle, Grantham McGregor, Black, Walker, & Wachs, 2007). Mathematics is a compulsory subject for all students at the secondary level in Nepal. This view is held by curriculum developers, teachers, parents, and students alike. Mathematics need not be learned by students in secondary for the sake of career choice or advancement but students should be able to learn mathematics with understanding and therefore be able to apply mathematical ideas later in life (Cockcroft, 1982 and Stanic, 1995).

The government has prepared a five years Master Plan (2013-17) to integrate ICT into school education. The basic problem in the installation of the infrastructure to fully equip the 34000 schools with ICT facilities requires a huge amount of money. Which is very challenging for the Ministry of Education (MoE) with its funding. The major reason behind this is the financial crunch. Although the government spends 16 percent of the national budget on Education Sector most of them are consumed by teacher salaries. The other side of this is even crucial; it is the curriculum and pedagogy. Updated curriculum and teacher training are essential parts of ICT implementation. In this regard, some works have just begun in the Nepalese educational system. In pre-service teacher education programs ICT has been an elective subject but the products will be knowledgeable in all aspects of integrating ICT in education in general and the classroom in particular. (Country Report; Nepal.2012 and 2013)

A research report produced by Becta (2003) highlighted that ICT provides fast and accurate feedback to students, and speeds up computations and graphing, freeing students to focus on strategies and interpretation. The use of interactive multimedia software also motivates students and leads to improved performance. Further, research studies showed that more students finish high school and many more consider attending college when they routinely learn and study with technology (Becta, 2003). In another study, it is found that teachers with routine access to computers tend to employ teaching practices that put students at the center of learning & Teachers' perceptions of the use of ICT as an instructional tool in Mathematics and Science. (Rockman, 1993)

The success of ICT integration is hindered by many factors. The main problem faced by many teachers is lack of training. Mellon (1999) points out that forcing technology down the throats of teachers without adequate training or support, and without allowing a reasonable time frame, is unlikely to improve student performance in every classroom.

Becta (2004, p.7) concludes that "many teachers who do not consider themselves to be well skilled in using ICT feel anxious about using it in front of a class of children who perhaps know more than they do." This study revealed that ICT was used rarely and only to some degree, mainly by individual teachers with ICT confidence and competence. Teachers who lacked the necessary skills and strategies tend to turn a blind eye to the integration of ICT to avoid frustration and confusion on the part of learners. This shows already that it is not only operation skills that are needed for the effective integration of ICT, but teachers also need to manage their classes by ensuring that all learners engage fully in the activities at hand and that assistance is rendered at all times. Additionally, teachers can only gain the necessary

skills and competencies if they are exposed to or have access to resources. However, the findings of this study indicated that teachers did not have access to ICT resources.

Nevertheless, there are some critical questions in the context of Nepal. Do all students have access to quality internet to attend the classes without disturbance? Are the teachers well-equipped and trained enough to run the virtual classes effectively? Moreover, are all the students able to use this opportunity for virtual learning? By virtual classes learning mathematics is easy or difficult there is raises many questions. By virtual classes enhances the quality of mathematics? What are the student's attitudes towards virtual classes learning mathematics, teaching-learning activities of virtual mathematics classes, availability of internet facilities, and evaluation system of virtual mathematics classes? They argue that effective communication between instructors and students must be established to motivate students to learn and to facilitate cognition processes in virtual learning environments (Brindley, Walti, & Blaschke, 2009; Jackson, Jones, & Rodriguez, 2010). The current literature suggests the influence of the instructor on student success, the questions that remain are, what are student perceptions about virtual learning during a pandemic situation in mathematics education, and how can the results impact the development of pedagogy to create positive learning environments that encourage mathematics students to learn? So, many researchers have concluded that mathematics virtual learning is more complex rather than other subjects. Therefore, these profiles mentioned above help to measure virtual learning during a pandemic situation in mathematics education.

Nowadays the students of mathematics education have been aware of the facilities and the academic excellence of the institutions. Students are not satisfied with the traditional teaching-learning approach. There is a demand for ICT-based teaching and learning. The academic achievement of students is decreasing day by

day. In this context based on reality, this research has tried to identify the factors which affect student satisfaction and it may be helpful to make strategic planning and to motivate the students of secondary level in the days to come.

Statements of the Problem

The statement of the problem is the description of an issue currently existing which need to be addressed. It provides the context of the research study and generates the question which research aims to answer. So, the statement of the problem is the focal point of any research. The problem of the study was mainly concerned with the infrastructure for ICT and the intention to use it by the teacher in Mathematics class at the secondary level. It is also included what and how to use it as integrated with Mathematics. In our context most of the students at the secondary level do not like mathematics subject as well as major subject due to possibility of failure in examination. When I studied at school level there was not opportunity of use of ICT at class. There was always use of traditional method for solving problem. Use of ICT takes role model for effective Mathematical knowledge .Most students want to study mathematics integrating with the advanced manipulated and animated technologies for making mathematics learning more realistic ,funny enjoyable and interesting. By using ICT as a tool for learning those teachers can maximize the impact of ICT in mathematics education (Becta,2003). Use of ICT promote collaborative learning.

Knowledge is expanding day by day so teaching is becoming one of the most challenging Profession in our society. While learning mathematics, learner expect from facilitator meaningful knowledge rather than just knowledge and skills (Hmelo Silver, C.2004). In this modern period the use of Digital technology in teaching mathematics provides new possibilities in teaching profession. In teaching learning

use of ICT was not sufficient .so, from this topic I will find out the contemporary situation of availability of ICT tools at mathematics class and current status of use of ICT in mathematics class and also will find opportunity and challenges of ICT at secondary level mathematics teachers and students.

Objectives of the Study

The objectives of this study were as follows:

1. To find out the status of the use of ICT in Mathematics class at Dhading District.
2. To find out the opportunities and challenges to practice ICT at secondary level mathematics teachers and students.

Research Questions

The Research Questions of this study were:

1. What is the status of the use of ICT in Mathematics classes?
2. What are the opportunities and challenges to practice ICT at secondary level mathematics teachers and students?

Justification of the Study

The ICT brings more rich materials to the learner to use maximum senses to get the information. Information in different forms like text, audio, video, or other media is also to be transmitted to the users. The recent trends of learning through ICT in different forms like online learning, e-learning, virtual learning, virtual university, e- coaching, e- journal are practiced by different institutions and organizations, etc. The taste and flavors of learning according to the modern trends everyone wants to be up-to-date which is only possible with the help of ICT. Hence the studies have the following significance:

- It provides variety in the presentation of content which helps the learners in Concentration.
- It provides better understanding in teaching and learning mathematics.
- It helps to bring positive attitude to learning mathematics.
- It would help the teacher.

Delimitations of the Study

Due to the constraints of time, expenses, and other related factors the researcher won't overcome the entire field. So it has some limitations & delimitations which were as follows:

- The study was limited to the Dhading district only.
- The population of this study was limited to grade IX and X Students of Shree Palpa Samari Bhanjyang Secondary School of Dhading District.
- This study was limited only the secondary-level students.
- The study was based on qualitative analysis.

Definition of the Related Terms

Computer laboratory. A central area or room where computing activities are carried out for teaching and learning purposes. It can also be accessible to students after lessons.

ICT tools. some modern tools such as Mobile, Tablet, iPad, Laptop, computers, Radio, TV, calculators, Internet, DVDs, and different Software programs' etc. that are used in teaching and learning mathematics were considered ICT Tools in this study.

Online. Describes an instrument or sensor that is connected to a central computer as the World Wide Web was considered online in this study.

Secondary level. Intended for students who have completed their primary education and participated in the next level or class, in this study classes 9 and 10 were considered as for the secondary level.

Students. Somebody who studies at a school, or college was considered as the student in this study.

Chapter II

REVIEW OF RELATED LITERATURE

The review of theory and literature involves the systematic identification and analysis of documents related to the study undertaken. Scientific research is based on past knowledge. The previous studies cannot be ignored because they provide the foundation for the present study. Within this assumption, some works relating to this topic are presented here.

Empirical Literature

Dahal & Dahal (2015) conducted a study entitled "Opportunities and challenges to use ICT in Nepalese mathematics classroom" ICTs provide a great opportunity for schools/universities in developing countries (Like ours) to improve their teaching and learning processes. So far, most of the schools/universities in developing countries possess basic ICT infrastructures such as internet, computers, video, audio, and mobile technology facilities that form the basis for the establishment of e-learning. It argued that schools/universities in developing countries should adopt e-learning technologies to improve teaching and learning processes. Pedagogical, technical and cost issues should be taken into account for each specific technology when integrating ICTs in teaching and learning practices as challenges. Therefore, before implementing the ICT familiar curriculum at the school to university level, the Ministry of Education Nepal, Curriculum Development Centre, and other related sectors need to think about removing the challenges that we are facing. We think at first the Ministry of Education needs to make and implement suitable policies, awareness programs, training programs, etc. related to ICT, and also local educational sectors are also required to actively involve for develop and implement the ICT familiar curriculum in each educational level.

Danai (2017), carried out research entitled "effectiveness of ICT in teaching Geometry". The purpose of the study was to find out the effectiveness of ICT in teaching Geometry at the secondary level and compare the achievement of a student of students taught by using ICT tools and without ICT tools. The population of the study was taken from the Kathmandu District private school students of grade 9 of the academic year 2073. The research was experimental so the researcher took two equivalent groups. One was the control (Taught by traditional method) group and another was the experimental (Taught by using ICT tools) group, he taught for 30 days in both schools. After analyzing and interpreting the data the researcher that the researcher found that the achievement of class nine students who were taught using ICT tools achieve better than the students who were taught without using ICT tools. Finally, the researcher concluded that using ICT tools in Geometry teaching is more effective.

Chong chee Keong, Sharaf Horan & Denial (2005) researched "A Study on the Use of ICT in Mathematics and Teaching," in Malaysia. This research developed a survey method to investigate the use of ICT and barriers to integrating ICT into teaching mathematics. The survey was carried out during a mathematics in-service course conducted by State Education Department. The finding concluded that the use of ICT in teaching mathematics can make the teaching process more effective as well as enhance the student's capabilities in understanding basic concepts. Nevertheless, implementing its use in teaching is not without problems as numerous barriers may arise.

Likewise, Moila (2006) researched "The Use of Educational Technology in Mathematics Teaching and Learning: An Investigation of South African Rural Secondary School." The investigation followed a mixed-method approach that was

more evaluative and was a case study. The study consists of 25 students and 5 mathematics teachers from Phusela Secondary School. The findings concluded that computer technology was not used in mathematics teaching and learning, there are no plans for the use of educational technology tools in mathematics teaching and learning, adequate educators training on the use of educational technologies in teaching and learning, and lack of relevant educational technology tools for rural schools.

By emphasizing the status of ICT use Shrestha (2015) did action research on the topic of "Status of ICT Use in Teaching/Learning Mathematics" by observing Students' and Teachers' activities through computer-assisted teaching in Heartland Children's Academy school of Kathmandu. There were 4 mathematics teachers among 26 teachers; three teachers out of four participated (i.e. almost 60%) and similarly 5.7% out of 114 students participated. Her study aimed to investigate the use of ICTs in Mathematics teaching and learning at Heartland Children's Academy. Therefore, this research study renders the ICT used situations and the problems to use ICT tools in Mathematics teaching and learning. She concluded that if students and teacher have no such rich environment of technology to teach or learn that cause to them. If not, then they surely learn through it. The limited access to ICT tools will result in anxieties and fears of the usage of the technology by teachers which is also a contributing factor to resistant to using computers in teaching and learning.

Likewise, to find the belief of teachers, Gautam (2005) did a study on "Teachers' Belief on Learning Geometry and its Manifestation in Teaching at Secondary Level". This is survey-type research and is interpretive in nature. The prime concern of this study was to study the secondary teachers' beliefs on learning Geometry and its manifestation in teaching. This study attempts to examine the urban

and rural teachers' beliefs as well as the comparison beliefs of teachers concerning the year of experience and assess the manifestation of internalized beliefs in teaching.

The population of the study consisted of all secondary mathematics teachers of the Parbat district. Twenty-eight teachers of the Parbat district were taken as the sample for the study with purposeful sampling from seventeen schools of the Parbat district, and three geometry classes of two different teachers in two different schools were observed for the study of the manifestation of internalized beliefs in their teaching. One belief scale was developed as the tool for collecting data for the study. This scale consists of 40 statements related to geometry learning, teaching, and evaluation. The Likert scale (5 points) was used to quantify the belief attributes data. The next method was observation to assess the manifestation of beliefs in teaching. The observation was done with the help of a prepared observation protocol.

The weighted mean, percentage mean, standard deviation, and two-tailed t-tests were used as statistical tools for the analysis of the data at a 0.05 level of significance. Qualitative analysis of the data was done with the help of Ernest's, Venhien, and Bruner's theories. Based on the interpretation and analysis of the data the following results were found:

- Secondary-level teachers have positive beliefs about learning geometry
- There is no significant difference between the mean beliefs score of urban and rural teachers.
- The mean beliefs score of a teacher who has been teaching for 0-5 years is significantly greater than the mean beliefs score of a teacher who has been teaching for more than 5 years.
- Teachers internalized beliefs towards learning geometry are not manifesting in teaching

Another research related to the use of lesson plans at the secondary level by a mathematics teacher.

Ghimire (2011) did a study on "Mathematics Teachers' Belief and Attitudes towards the Use of Lesson Plans in Secondary School." The main aim of this study was to investigate the beliefs and attitudes of mathematics teachers toward the use of lesson plans in private and public schools and to compare the beliefs and attitudes of mathematics teachers toward lesson plans in public and private schools. The study also aimed to find the causes of not using lesson plans in classroom teaching.

To investigate the beliefs of mathematics teachers towards the use of lesson plans at the secondary level. The researcher used the opinionnaire form. An opinionnaire sheet contained twenty-five statements (positive and negative). The opinionnaire was administered among five teachers included in the sample and the questionnaire was used for ten teachers from the sample teacher. The chi-square test was used to investigate the belief and attitudes of the teachers towards the use of lesson plans and the t-test was used to compare the belief and attitudes of public and private school teachers. The entire test was used at a 0.05 level of significance.

The information from the questionnaire set was obtained in qualitative form and the data from the questionnaire was analyzed by descriptive method. The population of the present study contained secondary mathematics teachers from the Arghakhanchi district. The researcher found positive beliefs and attitudes toward the use of lesson plans in mathematics in public secondary schools and negative beliefs and attitudes toward the use of lesson plans in private schools. Also concluded that there is a significant difference between the mean score of public and private school teachers' beliefs and attitudes towards the use of lesson plans.

Theoretical Literature

The theoretical literature review help establish what theories already exist, the relationships between them, to what degree the existing theories have been investigated, and to develop new hypotheses to be tested. Often this form is used to help establish a lack of appropriate theories or reveal that current theories are inadequate for explaining new or emerging research problems. The unit of analysis can focus on a theoretical concept or a whole theory or framework. After reading the literature, several theories have been developed from a different perspectives. The information obtained from different literature is sorted under the main themes and stories.

ICT in mathematics classroom. National Council for Mathematics (NCTM) stresses that technology is essential in teaching and learning mathematics and it influences the mathematics that is taught and enhances the students learning. Both NCTM (The National Council of Teachers of Mathematics) and BECTA (British Educational Communications and Technology Agency) focused on the technology as enabling, as well as encouraging the learner to focus on reflection, verification, decisions making, and problem-solving (NCTM, 2000., BECTA, 2003). The prospect of ICT is a promising practice in the mathematics classroom, but the success of this exercise is mainly dependent on several issues, including teachers' perceptions of ICT skills, teachers' attitudes toward ICT contribution to mathematics teaching, and teachers' attitudes toward ICT contribution to students' mathematics learning. Teacher Passion for ICT in the classroom mathematics, mathematics teachers the presence of ICT in the classroom self-esteem and sense of control, and teachers aim to mobilize ICT in their education (Baya'a, 2013). These possibilities of ICT integrate a proposed practice into the mathematics classroom.

ICT in the classroom, especially in the incorporation of a positive outcome will depend on the following factors: infrastructures, administrative support, teachers' attitudes to the contribution of ICT for teaching mathematics, student's motivation, and teachers attitudes towards the role of ICT, that presence of ICT in the classroom mathematics teachers' self-esteem and classroom administration ability to integrate ICT in education for teachers and attractions. While pre-service teachers solve math problems, they focus on the social and socio-mathematical norms that are installed during the interactions of pre-service teachers (Tatsis, 2008). Like the change from informal practical situated mathematics to formal, generalized mathematics the inclusion of technology such as Mathematical software (examples include GeoGebra, Mathematica, etc.) may induce qualitative new aspects of its education. ICT may serve as a tool for learning powerful mathematical concepts, getting insight and understanding, and to do problem-solving. A critical issue is how this function may be started and sustained.

Connectivism theory. The latest contender in educational theory has been named Connectivism, a 'learning theory for a digital age' advanced by George Siemens (2005) in response to an awareness that technology is increasingly undermining many aspects of accepted teaching and learning and that prevailing learning theories are inadequate in the present era. Siemens, Downes, and Cormier constructed the first massive open online course (MOOC), Connectivism and Connect Knowledge 2011, partly to explain and partly to model a connectivist approach to learning. The theory of Connectivism explains how technologies have shaped new opportunities for people to learn and share information across the World Wide Web. These technologies include web browsers, email, wikis, online discussion forums, social networks, YouTube, and any other tool which enables users to learn and share

information with other people. A key feature of Connectivism is to see connections between information sources and to maintain that connection to facilitate continual learning. Stated simply, connectivism is social networked learning.

The thesis is that knowledge is distributed across a network of connections, and therefore that learning involves the ability to construct and traverse those networks (Downes, 2007). Connectivism is characterized as a reflection of our society that is changing rapidly. Society is more complex, connected socially, and globally, and mediated by increasing advancements in technology. Rather than a new learning theory, connectivism offers an educator a model or mental representation that portrays something that cannot be observed or experienced directly (Dorin, Demmin, & Gabel, 1990). Connectivism and Learning: - For Siemens (2005), it is the connections and the way information flows that result in knowledge existing beyond the individual. Learning becomes the capability to tap into significant flows of information and to follow those flows that are significant. He argues that: Connectivism presents a model of learning that acknowledges the tectonic shifts in society where learning is no longer an internal, individualistic activity. Learning (defined as actionable knowledge) can reside outside of ourselves (within an organization or a database). Siemens (2005) identifies 8 principles of connectivism. He says that Learning and knowledge rest in a diversity of opinions. Connectivism specially talks about nodes. Learning is a process of connecting specialized nodes or information sources. It states that learning may reside in non-human appliances. When students are able to see connection between fields, ideas and concepts then it becomes core skill. Siemens argues that for facilitate continual learning there is most important of nurturing and maintaining connections. He says that decision-making itself is a learning process and choosing what to learn and the meaning of incoming information is seen through the

lens of a shifting reality .So siemens says learning may reside in non-human appliances and specially says learning through information sources.

While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision. Connectivity such as Siemens and Downes tend to be somewhat vague about the role of teachers or instructors, as the focus of connectivism is more on individual participants, networks, and the flow of information and the new forms of knowledge that result. The main purpose of a teacher appears to be to provide the initial learning environment and context that brings learners together and to help learners construct the learning environments that enable them to connect to ‘successful’ networks, with the assumption that learning will automatically occur as a result, through exposure to the flow of information and the individual’s autonomous reflection on its meaning. There is no need for formal institutions to support this kind of learning, especially since such learning often depends heavily on social media readily available to all participants.

Connectivism is the notion that knowledge is distributed across a network of connections, and therefore that learning consists of the ability to construct and traverse those networks (Downes, 2007). Downes stated that connectivism implies:

- Seeks to describe ‘successful’ networks (as identified by their properties, which he has characterized as diversity, autonomy, openness, and connectivity) and
- Seeks to describe the practices that lead to such networks, both in the individual and in society – which he has characterized as modeling and demonstration (on the part of a teacher) – and practice and reflection (on the part of a learner).

In Connectivism it is the collective connections between all the 'nodes' in a network that result in new forms of knowledge. According to Siemens (2004), knowledge is created beyond the level of individual human participants and is constantly shifting and changing. Knowledge in networks is not controlled or created by any formal organization, although organizations can and should 'plug in' to this world of constant information flow, and draw meaning from it. Knowledge in Connectivism is a chaotic, shifting phenomenon as nodes come and go and as information flows across networks that themselves are interconnected with myriad other networks.

This study was informed by the constructivist learning theory which has its origins in the field of psychology and was made popular by Dewey (1966), Bruner (1996), Piaget (1970), and Vygotsky (1978). Constructivism, according to Burning et al. (2004, as cited in Schunk, 2009), is a psychological and philosophical perspective contending that individuals form or construct much of what they learn and understand. Schunk (2009) emphasizes that one of the constructivist assumptions is that teachers should not teach in the traditional sense of delivering instruction to a group of students. Rather, they should structure situations such that learners become actively involved with the content through the manipulation of materials and social interaction.

Research has shown evidence of how ICT integration helps learners to construct their knowledge. Lourdusamy, Koon & Khine (2001) emphasizes that the development of ICT has provided new opportunities for delivering instruction and at the same time, the constructivism movement in instructional design emphasizes the importance of providing meaningful, authentic activities that can help the learner to construct understanding and develop skills relevant to solving problems rather than

feeding them with more and more information. In addition, Olsen (2000, as cited in Lourdasamy et al., 2001) thinks that through the use of technology, teachers can provide opportunities for students to learn how to think critically and conduct discussions with their peers, supported by ICT. According to Roblyer, Edwards & Havriluk (1997), ICT addresses the following needs as identified by constructivism:

- Making skills more relevant to students' backgrounds and experiences by anchoring learning tasks in meaningful, authentic (e.g. real life), highly visual situations;
- Addressing motivation problems through interactive activities in which students must play active rather than passive roles;
- Teaching students how to work together to solve problems through group-based, cooperative learning activities;
- Emphasizing engaging, motivational activities that require higher level skills and pre-requisite lower level skills at the same time.

The role of technology in education. Technology is often equated with equipment (e.g. computers, CDs, DVDs, VRCs) but the meaning is much broader (Schunk, 2009). Jonassen et al. (1999, as cited in Schunk, 2009) describe technology as the designs and environments that engage learners. Technology in the context of this study refers to machines and equipment, and the soft part is software and ways of doing things that are based on modern knowledge about science and the computer.

Jonassen et al. (1999, as cited in Schunk, 2009) present the following functions of technology that are relevant to learning:

- Tool to support knowledge construction.
- Informative vehicle for exploring knowledge to support learning by constructing.

- Context to support learning by doing.
- Social media support learning by conversing.
- Intellectual partner to support learning by reflecting.

Use of computers in school. Han (2008) argues that one big difference between computers and teachers is that computers will never get tired, and will repeat the same thing again and again without complaining. Whatever a computer is programmed to do, it can do over and over as often as necessary, which is an advantage, particularly for slower students. Furthermore, computers can retain teaching resources for a longer time, which is almost impossible in traditional classes.

Another advantage of ICT is that whereas in most cases, printed books limit teachers to using the same information repeatedly over the years, computers and ICT have vast resources of information that can be accessed at any time and which is upgraded from time to time. Karchmer (2001) argues that when readers engage in print-based text, they are confined to what is written on the paper in front of them reinking et al. (1997, as cited in Karchmer, 2001) suggest that electronic texts eliminate such boundaries and provide readers and writers with the opportunity to easily connect to relevant material.

The impact of computers upon teachers has, with some notable expectations, been less marked, as many teachers still feel very uncertain about the new technology, and this uncertainty has been exacerbated by the feeling that their pupils often know more about it than they do (Warry & Medwell, 1991). With the integration of ICT, teachers are expected to perform certain tasks on the computer such as tying worksheets, tests, activities, and summaries, and searching for information on the www. In their research, Hill & Slater (1998) mention that the Internet enables learners

to engage in a communicative dialogue. This can be done through communicating across the globe with other learners.

The use of ICT Tool which is in any form whether it helps modern teaching and learning or not, for that surety this study be conducted in the form of a survey, and the opinion, and perceptions be collected from different teachers and students. The availability of the tools is basic which helps to recognize whether they were used or not.

Research Gap

After the thorough study of the different books, journals, research papers, and different policy documents related to ICT in the mathematics classroom, and reviewing them analytically. It has been found that ICT helps both teachers and enhances their teaching and learning activities. The government of Nepal and the Ministry of Education, Science and Technology have provisioned for the implementation of ICT integration in classroom teaching learning. However, most of the research shows the numerous issues and problems for effective implementation of ICT integration in the mathematics classroom.

Conceptual Framework.

The study is on “**Availability of ICT Tools in Mathematics Classroom: A Case Study**” and was based on the following conceptual framework.

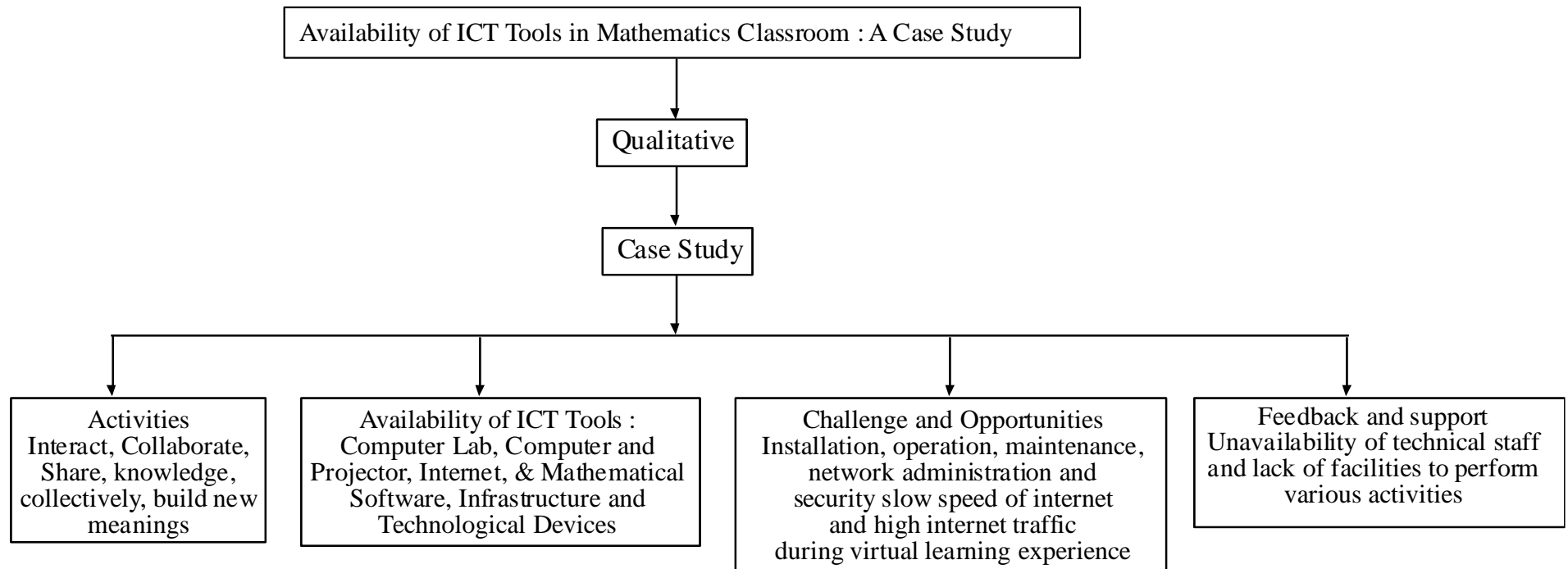


Figure 1: Conceptual Framework

Chapter III

METHODS AND PROCEDURES

This chapter begins with the design of the study, the population of the study, sample and sampling strategy, study area/field, data collection tools and techniques, data collection procedure, and data analysis procedure. Qualitative research takes an interpretative, naturalist approach to its subject matter, qualitative researchers study things in their natural setting, attempting to make, phenomena, in terms of meaning that people bring to them, so, Researcher had chosen this methodology. The chapter explained the plan and method of study which helped to achieve the objectives of the study.

Design of the Study

The qualitative research design/method helps to discover the individual views for data collection such as group discussions, individual interviews, and participation of others (Carol, 2016). It is difficult for measuring and calculating the numerical value of students' difficulties in learning mathematics from the quantitative method; therefore, Researcher used the qualitative research method. Qualitative research can be regarded as 'naturalistic inquiry' in the sense that it is conducted in a natural setting by trying to avoid any intentional manipulation and distortion of the environment of the informants by the researcher (Creswell, 2007).

Case study approach. According to Jack & Hersh (2008) case study research approach is a research methodology that helps in the exploration of a phenomenon within some particular context through various data sources, and it undertakes the exploration through a variety of lenses to reveal multiple facets of the phenomenon. In the case study, a real-time phenomenon is explored within its naturally occurring context, with the consideration that context creates a difference (Peter & Kaarbo,

1999). The major concern of my study was to find out the perception of students about which factors affected their learning of mathematics. So, for achieving this major concern the case study approach was adopted under the qualitative research method because according to Creswell (2007) in the case study approach, the data is collected through direct observation in a natural setting, and the actual incident on the spot. Here, the case is the process of selecting a limited number of students & doing research on those students, and then collecting data from them. And also, the objectives of this study were to explore the causes of difficulties faced by students in learning mathematics and to explore the ways to improve the interest of students in learning mathematics. Researcher thought that only the case study approach could fulfill these objectives, so Researcher applied this approach to this study.

Selection of Respondents and Selection Strategy

First of all, the list of secondary schools prepares from the list maintained by the district education office. There were Thirty-eight secondary schools in Dhading district, according to the district education office in Dhading. But Researcher had chosen one school from the public selected by purposive sampling. Thus, the four students were selected as a sample for the case study. And also, the head teacher and two mathematics teacher from the sample school were selected as respondents for data collection. Based on the school's annual results with high, medium, and low score abilities students were selected according to their knowledge level. Thus, Researcher had use the purposive sampling technique for the selection of participants.

Study Area/Field

The research area selection is also a very important task for the study to obtain easy access, establish immediate rapport with informants, and gather data directly related to the research objectives. Every study needs a study area; the researcher was

chosen one public secondary school in Dhading district. The name of the school is Shree Palpa Samari Bhanjyang Secondary School which was in Nilkantha Municipality-09 Dhading.

Data Collection Tools and Techniques

To fulfill the purpose of the study different tools were selected for data collection. Thus, the in-depth interview, observation notes, and document analysis were used as tools for the data collection.

In-depth interview. Kerlinger (1986; as cited in Shrestha, 2016) describes an interview as face to face interpersonal role situation in which one person, the interviewer, asks a person being interviewed, the respondent, questions designed to obtain answers pertinent to the purpose of the research problem. The in-depth interview also known as an unstructured interview could be regarded as an informal interview. It was used to discover the in-depth understanding of people in the context under the study (Bailey, 1982; as cited in Adhikari, 2006). Researcher developed different interview schedule forms for students, parents, and mathematics teachers. The in-depth interview was conducted with the mathematics teacher, students, and their parents using open-ended or semi-structured questions. After observing the mathematics classroom, Researcher had taken an interview with the mathematics teacher and students then Researcher asked some questions to the mathematics teacher and students related to difficulties in mathematics. The in-depth interview was helping me with face-to-face communication with the students and also to get information about the personal gestures, habits, and attitudes of the students towards mathematics. It also helped me to understand the personal thoughts, ideas, and experiences of the students. Researcher used this tool as required by the key students and their mathematics teacher.

Observation note. Observation is a kind of tool that helps to seek knowledge through the use of senses i.e. eyes, nose, tongue, and skin. It has great importance not only in research work but also in our daily lives (Adhikari, 2006). Observing in a setting is a special skill that requires addressing issues such as the potential deception of the people being interviewed, impression management, and the potential marginality of the researcher in a strange setting (Hammersley and Atkinson, 1995; as cited in Creswell, 2007).

Observation note was used to identify the student's activities, the teacher's activities, the interaction between students-students and students-teachers, classroom management and the physical environment of the classroom while teaching/learning mathematics. The already established semi-structured observation forms were used to fulfill the intended objective of the study. The different outlooks of the student's behavior in the classroom and the activity of mathematics classes were carefully observed in the school. Researcher observed three times mathematics teaching/learning classrooms of each sample school. And also, observed the family background of the students like their daily life, their home environment, and their parent's professional and economical condition. Observation helped me in collecting detailed information about respondents, and their everyday practices and capture the actual experiences of the participants.

Document review. The review of documents is an approach, that researchers use to gain a detailed understanding of the setting by analyzing the content of a given document (Bajaracharya, 2009 cited in Shrestha, 2016). In this study, Researcher reviewed some documents which are closely related to students such as students' previous result sheets, students' marks sheets, files of schools, etc. And also, reviewed various journals and articles which helped me identify the guideline for observation and components for an interview as well as arrive at the research objectives.

Data Collection Procedure

The school's record is studied such as mark ledger of students, teachers, profiles, physical facilities, and other relevant documents. The researcher records the behavior and activities of both teachers and students during teaching-learning activities. Firstly, for the study, Researcher visited my sample school. For the research, an interview was conducted with teachers and students to collect the required facts. Researcher organized the interview schedule in which teachers and students for the teacher's knowledge of the subject matter. The parent's role was discussed with the parent and subject teacher.

Primary sources and secondary sources were used for the data collection process. The primary information was collected from mathematics teacher, mathematics students, their parents, and as well as from educated people in society. And secondary information was collected from books, articles, reports, newspapers, and so on. After collecting the data, the collected data were interpreted and analyzed then the finding and conclusions have been drawn. Related documents are also reviewed and analyzed based on need.

Data Analysis Procedure

The data were collected in different ways. The different data were collected from interviewing the students, records of school, as well as from the various people who were interested in this case. While analyzing the data head teachers, students, and parents would involve. We collect important data and remarks from those people. The researcher collects data through interviews with head teachers, teachers, students, and parents. School records of students help the researcher to collect data. The collected data in qualitative research is not of structured form and it is time for the researcher to do a lot in making a workable structure of the collected information to make the meaning or theory. First of all, Researcher organized and edit the collected

information from interviews and classroom observation then generated the difference code according to the responses of participants. Researcher adjusted those codes according to their similarities and also, and Researcher gave the title for them which is known as a theme. At last, Researcher analyzed and interpreted those themes by using the constructivism theory and conceptual framework which Researcher have developed in the literature review.

Quality Standards

After completing the construction of the research tools, it is necessary to maintain quality standards. For quality standards, Researcher used cross-match, triangulation, member checking, and prolonged stayed in the field. For quality standards, Researcher followed the following ways;

Credibility. Credibility is the key criterion of the quality standard in qualitative research. To maintain the credibility of my research Researcher have spent more time on interviews, and one week for classroom observation. Researcher also gave a special focus on document analysis. And also, to maintain the credibility of my research Researcher tried to spend as much time as the observation needed and engaged with different people with their work.

Transferability. Transferability is in preference to external validity in the positivist approach. Guba and Lincoln (1985) "Transferability showing that the finding has applicability in other contexts." To maintain transferability, Researcher took photos of classroom teaching and voice recordings while taking interviews with participants. And also, to maintain transferability, Researcher tried to capture most of the scenario by using the thick description of observation, interview, and my meaning-making.

Dependability. Dependability is in preference to reliability. It shows that findings are consistent and could be repeated. This is the third standard for judging

qualitative standards and refers to the stability or consistency of the inquiry processes used over time. For this, Researcher took a rational idea to select the people. Also, Researcher tried to ensure credibility and transferability to maintain dependability. To maintain it Researcher presented the logic used for selecting people and events to observe, interview and include in the study.

Conformability. Another quality standard for qualitative research is conformability, which refers to the quality of the results produced by an inquiry in terms of how well they are supported by informants who are involved in the study and by events that are independent of the inquiry (Khanal, 2019). So, to maintain conformability before concluding information Researcher reviewed that information myself several times and sometimes Researcher confirm that information with my other students/friends before concluding information as well.

Ethical Considerations

If any kind of research involves the person, special attention should be paid to the person's rights, dignity, freedom, and privacy (Khanal, 2019). The ethical considerations of my study were Researcher observed the classroom only to take permission from the subject teacher of the related school, interviews conducted only after giving all the prior information to the participants about the study and getting their approval, data has not been collected for my gain and my benefit, respecting the diversity in school the data will collect in a biased manner, the comfortable language used in the data collection process for easily understandable to the participants, and at last name & address of participants have been published in the statistics only with their approval.

Chapter IV

ANALYSIS AND INTERPRETATION OF DATA

This chapter deals with an analysis and interpretation of the collected data. Analysis of data is a process of inspecting, cleaning, transforming, and modeling to highlight useful information, suggestions, conclusions, and supporting decision-making (Best and Khan, 2009). The most important part of the study is to analyze the collected data because the essence of the study cannot be found without that. Data analysis involves reducing and organizing the data, synthesizing, searching for significant patterns, and discovering what the important (Khanal, 2019). The data of the present research work was analyzed analytically, descriptively, and qualitatively.

The research was a case study about the burning issue of Information and Communication Technology in teaching-learning mathematics and its real application in the mathematics classroom. To meet the objective of the study, the researcher collected the data from one Government school Shree Palpa Samari Bhanjyang Secondary School of Dhading District., Nilkantha Municipality-09 Dhading.

Data were collected through Classroom observation and Interview Guidelines. The main respondents of this study were purposefully selected the Headteacher, mathematics teachers, and students of the case school. The researcher collected the data in audio form by recording the sinterview on a mobile phone and also noted in field notes. The primary data were first transcribed in the respondent's language and then translated into English. After that coding, categorizing, and finally, the theme was made. The result of the collected data was analyzed in the following main themes/sections/topics on basis of my conceptual framework.

Introduction about Case School

The researcher has selected a sample school " Shree Palpa Samari Bhanjyang Secondary School of Dhading District., Nilkantha Municipality-09 Dhading," established in 2032 B.S. which is the one public school of Dhading District located at Nilkantha Municipality-09 Dhading. It had upgraded to lower secondary school in 2033, and now, it is running pre-primary to class 12 from 2065 B.S. This was one of the popular schools of Dhading having excessive numbers of students. Because of having excessive numbers of students, well physical infrastructure, and immense effort of the stakeholders; the Ministry of Education, Science and Technology has been nominated as one of the model schools of Nepal. The school has 4 buildings, and also two buildings with 16 classrooms were in the way of construction. It had its one computer lab, and other ICT infrastructures supported by different government and non-governmental organizations.

Demography of Case Participants

Teachers are an important input in the teaching-learning process for the better functioning of the school including other input as physical facilities and educational materials. Different literature and research have given an important place for teaching effectively. Teacher's number, qualification training, and experiences are important factors for better performance in classroom teaching and school holdings. There are 18 members of staff and 317 students in this school. Among them 36 students studying in grade nine; 11 students read optional mathematics. There are two mathematics teachers in this school and they have taught optional mathematics for one year by one teacher and another next year by another teacher respectively. Hence, according to several students; there are sufficient mathematics teachers at the secondary level.

Teacher Name	Post	Qualification	Training	Teaching Experiences	Remark
Bal Bahadur Ale	Head Teacher	M.ED/M.A	Trained	11 years	Permanent
Tilak kami	Math Teacher	M.Ed	Trained	4 years	Permanent
Bishnu Dhimi	Math Teacher	B.ED	Untrained	2 years	Non-permanent

The table shows all the respondents, teachers are permanent and have experience in the secondary level. The teachers have at least a Bachelor's degree in their related subject. The major tools of school improvement are teachers' quality and adequacy. The present status of this school shows that there were adequate numbers of experienced and qualified teachers. The headteacher is qualified, highly experienced, and able to run the administration of the school. One mathematics teacher at this school is trained, qualified and experienced, whereas another teacher is untrained but qualified and experienced in the teaching field.

Availability of ICT Tools

To accomplish the first objective, of the study, the researcher interviewed the head teacher, mathematics teacher, and students of the case school, and observes ICT infrastructures like computer laboratories, and mathematics classrooms. After the interview with the participants and observation of the school ICT laboratory and mathematics classroom, the researcher presented the result in the sub-sections of Head Teacher, Mathematics Teachers, Students, and Observation.

Head teacher. The role of the head teacher in a school is the administrator, who has the responsibility to maintain the overall management of the school. Headteacher argued that as the government of Nepal initiate to integrate teaching-

learning activities with technology; most of the government schools were facing different types of problems for the effective implementation of it. As it is one of the model schools selected by the Ministry of Education, Science, and Technology, it has well infrastructures constructed with the support of different Governmental and non-Governmental organizations. The school has its computer lab and Over Head Projector is connected to most of the classrooms. To establish the ICT lab of this school the Non-Governmental organization Himalayan Trust provided financial and technical support to this school. In my sample school one Computer Lab, 10 Desktop Computers, 1, Overhead projector, 2 Photocopiers, 1 Printer, 2 Laptops, and 1 Telephone. This shows that the school has sufficient ICT infrastructure for effective implementation of ICT-integrated teaching-learning. The headteacher of the school was responsible and accountable to establish the ICT infrastructures by coordinating with different Governmental, Non-Governmental organizations. Headteacher said,

"Government of Nepal has provisioned for the ICT integrated teaching-learning strategy. Most Public schools are still the out of access to ICT facilities. As it is one of the model schools of Dhading districts having a large number of students, the schools have their computer lab and other ICT infrastructures. As schools have excessive numbers of students the available ICT infrastructures are not sufficient for all students. There are 2/3 sections in each class but the school has only one computer lab having only 10 computers. It's so difficult to participate all students in the computer lab regularly. This school is located in a geographically arduous area even though the national transmission line of electricity is not connected till now. Accordingly, to cope with the problem of electricity we have the facility of power backup for up to 2 hours even if they get out of power supply from the

leading electric supplier. For the internet service, the school has connected two Wi-Fi networks and now we have also access to the 4G network provided by Nepal Telecom."

Mathematics Teacher. There were two mathematics teachers in the school. Both of them were attempting for using different types of technologies in their classroom teaching learning. They had given more focus on using a computer or, multimedia devices in their classroom. Apart from the computer, they use a calculator, mobile phone, dynamic mathematical software (such as GeoGebra, Mathematica), etc. in their classroom teaching learning activities. To amplify the images, videos, dynamic mathematical plots, and figures they use a projector also in the classroom. One mathematics teacher added that.

"As we are in the 21st century known as the age of science and technology, teaching-learning cannot be far away from it. Many technological tools and techniques have emerged in the field of teaching-learning. Particularly, mathematics teachers can use various devices like calculators, projectors, computers, mobile phones, and so on. Similarly, various mathematical software like GeoGebra, Photo Math, Mathematica, Latex, etc. were developed which assists to clarify the mathematical contents meaningfully and realistically."

Teachers claimed that if they are going to implement new they need to give a requisition to the school administration, it's a lengthy process and takes a long time even to repair any devices. Because of the carefulness of the institution, most of the resources are already get ruined. The minimum number of staff needs to take care of all the technological devices. Another mathematics teacher added that;

"Before being a mathematics teacher at this school, I had studied 'ICT in Mathematics Education' as a subject for my Master's Degree, when I became at this school and try to integrate mathematics courses into ICT, I faced several problems including lack of resources. Here local mini-hydropower may deteriorate from time to time. Our school has only one classroom where we can use multimedia tools to present our digitalized content in front of the students. So, I cannot use it more than once or twice a week. Though most of the teachers want to use technologies in their classes and they are making their lesson plans according to that, they are not getting opportunities."

Students. Almost students agreed that they usually use a calculator in their mathematics class for numerical calculation. They do not get any chance to use the computer and other technologies in their classroom even at school. Teachers use their laptops and projector to show the presentation made either pictures, videos, or, any other interactive content. Instead of that, the students have almost no chance to operate technologies in classroom activities. They claimed that they were not allowed to use a mobile phone on school premises and it's strictly prohibited to bring mobile phones to school premises, though some of the students use these technologies at their homes. One of the class 10 students argued that,

"Our school has prohibited bringing mobile phones into the classroom even on school premises. Teachers sometimes use their laptops and projector to clarify and visualize the mathematical contents but students have no more access to operate them than watching as a passive learners in classroom activities. However, I have the mobile phone at my home; I use it to search if I felt any problem at the time of the study."

Most of the students were there from low economic status. That's why they are impotent to have their computer and other technological devices at their home, and because of having insufficiency of ICT infrastructure in their school, they were unable to use ICT tools even in their school also. One of the class 9 students *argued that;*

"There is only one lab in our school, and because of the excessive numbers of students in our school, we have less opportunity to go to the laboratory and use them. Also because my family's economic status is low, I have no technological devices even an android mobile phone now."

Observation. Most of the Nepalese schools were facing a lack of infrastructure resources to implement the ICT-integrated teaching-learning activities. Though this school is located in an arduous rural area, nevertheless this school has its computer lab is connected in most of the classrooms but it's not enough for all students. Whereas there were only 10 computers in the computer lab. There was no more equipment in the classroom more than one projector and the teacher's laptop. So, there was no opportunity for students to use technology in their classrooms. From the researcher's observation, it has been found that both mathematics teachers use laptops and projectors in their classrooms to clarify the concept graphically and figuratively. It is no evidence that they teach every content integrated with multimedia ICT tools, they only do so once or twice a week. Students were interested to study integrating with dynamic and interactive technological devices nevertheless because of the insufficiency of ICT infrastructures it is difficult to do as their desire.

In sum, School Sector Development Plan (SSDP, 2016-2022) emphasized establishing and ICT enabling learning environment by including ICT prerequisites as enabling conditions in secondary schools and enhancing the teaching process, training teachers, incorporating secondary curriculum, developing portals and websites

including e-libraries and preparation of ICT based teaching learning materials initially for Science, Math and English. In this regard, each of the schools either public or private is effortful to implement ICT integration in school. Nevertheless, most government schools are still facing a problem of a lack of infrastructure for effective and efficient implementation of ICT integration in school and teaching learning activities.

The theory of connectivism states that technology has created a new opportunity for people to learn and share the information via World Wide Web. These technologies include web browsers, email, wikis, online discussion forums, social networks, and other tools (Seimens, 2005). ICT provides a better platform for teaching-learning, but because of the unavailability of sufficient technological devices and lack of internet services the student even teachers have less opportunity for integrating mathematics teaching-learning with new technologies. Most of the students were impotent to use technology to enhance their study at their home also. Though students from a good economic status and especially Boys students have access to ICT devices at their home, those students who were from low economic status and especially girls have no technological devices even an android mobile phone.

Opportunities of using ICT tools at teaching time

To investigate the factors of ICT to be positive the researcher used interview guidelines which were given in Appendix. In this section, Researcher asked many questions according to interview guidelines related to the opportunities of ICT tools in mathematics education.

one of the respondents said, "From the ICT-based class I got many benefits and opportunities like, improve technical skill, learning by visualize method,

time-saving, improve communication skill, I learn many more thing from an online class I feel more comfortable and my technical and communication skills improve by the ICT that is the great opportunities for me. I am habitual with e-mail communication helping our professor, online classes help us for finishing our courses on time and especially online classes get me opportunities to communicate with my colleagues. I can confidently say that ICT can develop learning ability".

This section covers the extracted themes that were derived from the analyses of data; each theme converses opportunities related to ICT and reflects the perspectives of students regarding ICT and their experience using ICT tools. The first open-ended question is "What are the opportunities for using ICT tools during teaching time?" After collecting responses from all of the students and teachers, a researcher has taken some representative topics which have received a lot of responses which are flexible, self-learning, with no boundaries, quality education, globalization, cost-benefit, etc.

Use of ICTs in Mathematics Teaching and Learning in School

The teachers of the school are urgently guided. In this case, the important thing is that if the trained teachers are taught to connect with ICT in mathematics, they will be able to apply it in future school courses. As illustrated, various mathematical images of geometry can be presented to the students using a projector. The use of ICT in two-dimensional and three-dimensional imagery will give an obvious idea to the students. With the help of the Internet, new information and data are always available to students. With different theories of trigonometry, it is possible to make ICT dependent on practical applications. Self-Regulated students are aware

of their academic strengths and weaknesses and are well-versed in the strategies they use to address the day-to-day challenges of academic work.

Interactive Visualizations and Explorations. High-level student engagement is achievable according to Brain research. There is strong evidence to suggest that visual pathways are involved even when working on symbolic number calculations. Opportunities with technology in math education provide learners with the chance to interact with mathematical concepts. One example of this is the use of the floor turtle by young children to assist their understanding of the concept of angle as an amount of turning.

Develops student ICT capability. The use of ICT resources in math provides the right opportunity to develop ICT capability in a meaningful and purpose-driven learning context. Students achieve this when the technology is 'transparent' in its use to such an extent that they hardly notice that they are using it to achieve the learning outcomes that you have set for them. This is the ultimate aim of developing ICT capability and that of this online course.

Self-Learning. Self-learning is anything you learn outside a classroom environment by yourself without a set curriculum or examinations. Many students have pointed to self-learning as an opportunity for ICT. Self-learning is a main feature or facility of ICT. Students consider self-learning as the main opportunity to learn according to their needs and desires of the student. The additional benefit of e-learning is that it is student-centered and focuses on ICT.

Student-centered learning (SCL), also referred to as learner-centered education, is a modern learning method that aims to put the students in the center of focus, rather than the teachers. Online learning is fundamentally student-centered, due to the easy implementation of student discussion boards and peer grading systems.

Self-learning is a process by which individuals take the initiative, with or without the assistance of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, and evaluating learning outcomes (Knowles, 1975). According to James Thomas, A self-paced system enables them to make progress with a rhythm that suits them. This type of system does not require attending live sessions; you can access the materials at any time that works for you. That's an advantage the traditional educational system cannot beat (Thomes, 2019). The research has demonstrated that self-paced learning leads to increased student satisfaction and reduced stress, resulting in improved learning outcomes for everyone involved. Some of the advantages of self-paced learning include efficiency, effectiveness, convenience, scalability, and reusability (Masie, 2019).

Virtual learning takes into consideration the differences between individual learners, and it allows students to practice their learning styles. In other words, students are not always required to pass all unwanted courses in a curriculum and they can choose specific topics of interest to them. All students have different learning styles and there will never be a one-size-fits-all type of solution that will match all students at once. That is why individualistic learning methods are some of the greatest advantages of ICT. ICT has the potential to be the most individualistic learning method ever made if implemented correctly. To recap, adaptive Virtual learning materials are designed to automatically change and adapt according to the knowledge, skills, and needs of each student.

Flexibility. Flexible learning provides students with full control and accountability for their learning. With the help of ICT, students can take lessons online during flexible hours. They can learn at their convenience anytime, anywhere sitting at any place. The students can be trained from all countries, places whether in

remote areas or countryside areas where education facilities are not available.

Students who study online can plan their schedule, without having to make personal sacrifices to meet the class attendance requirements of teachers and traditional universities.

There are responses from students. Flexibility is a main feature or facility of ICT. Students considered virtual learning as flexible means to access education, as per student's ICT helps them to learn anywhere, at any time, without any geographical barrier. The flexibility of online education is often the most appealing factor, contributing to too many students choosing to opt for this route over more conventional education. While it promises things like convenience and more freedom, flexibility itself also has a positive impact on the student's overall learning.

The major opportunities of ICT are that due to its convenience and flexibility, the resources are available from anywhere and at any time. One of the best opportunities for ICT is flexibility with time. It gives the students a chance to study at what time of the day or week they want and when best suits them. This also improves the organizing skills of students because they have more responsibility for their timing and studies as well. ICT, at its best, promotes the equality of education. ICT gives also flexibility to family planning in the context of family social events and in that way, ICT has a strong social significance (Ndzibah & Ofori, 2017) it extends its reach with the reach of technology and can encompass both part-time students and regular ones. It presents a convenient and flexible option and promotes active and independent learning without restrictions on time, be it on weekdays or weekends.

Students have the opportunity to analyze problems and explore ideas as well as develop concepts. Not only they can acquire knowledge together, but students are also able to share diverse learning experiences to express themselves and reflect on

their learning. Virtual learning makes many opportunities for educational institutions, business organizations, and learners. These opportunities are the effective use of information and communication technologies, delivery of educational services anywhere, anytime and to anyone, substantial cost savings, just-in-time access to timely information, and personalized learning (Milovanovic, 2010). There is not much difference between the research on Virtual learning faced by the student and the finding of the previous research. After collecting responses from all of the students and teachers, the researcher has taken some representative opportunities while taking a virtual class which has received a lot of responses, which Time flexibility, Location flexibility, Scope for Innovation & digital development, wide availability of courses & content, immediate feedback, with no boundaries, self-learning and are the opportunities while students taking ICT based mathematics.

Challenges of using ICT tools at teaching time.

This section covers the extracted themes that were derived from the analyses of data; each theme is a conversational challenge related to virtual learning and reflects the perspectives of students regarding virtual learning and their experience using virtual learning tools. The second open-ended question is "What are the challenges you face while using virtual learning?". These are the challenges for the student to know and understand virtual learning in this question. Challenges-related open-ended questions were asked to four students and two teachers. After collecting the response from all the students and teachers, the researcher has taken some representative topics which have received a lot of responses. Which is the unstable network, lack of Motivation, lack of technical knowledge, notification distraction and useless notification, shortage of devices, unnecessary advertisement, complexity, expensive, and security?

Lack of professional development opportunities. Lack of adequate opportunities for teachers to receive ICT-based training. Sufficient time for the teachers to train the subjects related to the practice. ICT and basic ICT training require curricular training about the curriculum. Providing educational training to teachers is more important than simple training for teachers about the use of ICT equipment (Johns, 2004). Teachers taking part in ICT-related professional development courses are not confident enough with their lessons regarding ICT. These courses were mainly about necessary ICT skills and did not teach teachers how to associate these ICT tools with their experiences. Training content should be blended with educational content technology in training courses for teachers to train using ICT resources in their respective subjects. Some parameters related to the technical knowledge and skills, the educational skills supported by the technology, the management of the classroom, and the knowledge and skills required by the teachers regarding the use of technology.

Lack of technical support when working with ICT tools. Teachers face technical problems, so teachers try to avoid using ICT. Therefore, timely assurances of technical support can help teachers provide appropriate lessons and provide lessons. Technical constraints include Internet connection failure and ICT equipment malfunction. In some cases, teachers argued that the fear of breaking the ICT equipment during the experience might discourage them from using ICT during their teaching practice. ICT training is useful enough for teachers, but the lack of technical support concerns teachers. Therefore, to encourage the use of technology, teachers should have proper arrangements to provide technical support.

Unstable network and internet connectivity. Main challenges faced by students while using the virtual learning method are unstable networks and unstable

internet connectivity. Responded to unstable internet, expensive internet, and expensive data charge most of the students are facing these issues while attending virtual class during the lockdown period. Nepal is a developing country; every student doesn't have wifi connectivity. Most students use mobile data for their online classes so it is expensive and unstable due to which students cannot continue their virtual learning.

Most of the people live in rural areas and Nepal has difficult geographic conditions which result in poor or no internet connection (Thapa, 2020). Internet is expensive, limited geographical coverage, and unstable if there is connectivity. According to respondents, the internet package in Nepal is comparatively expensive which discourages students to search for reading materials through the internet. Power supply, though it is more stable these days, also stresses students as well as instructors. According to respondents, the internet package in Nepal is comparatively expensive which discourages students to search for reading materials through the internet. Power supply, though it is more stable these days, also stresses students. The student's discomfort in ICT is because of late joining the class, disconnecting and reconnecting the classes frequently.

Lack of motivation. Lack of motivation is also one of the important challenges faced by students in ICT Education. Due to a lack of motivation, students did not complete their ICT classes and courses. Students responded that they are facing motivation issues with virtual learning. Lack of self-motivation among students continues to be one of the primary reasons why students fail to complete online courses. For many students, one of the biggest challenges of ICT learning is the struggle with focusing on the screen for long periods. With ICT learning, there is also a greater chance for students to be easily distracted by social media or other sites. In

traditional classrooms, numerous factors constantly push students toward their learning goals. Face-to-face communication with professors, peer-to-peer activities, and strict schedules all work in unison to keep the students from falling off track during their studies (Olaniran, 2007).

Students taking virtual learning courses find that they are often required to learn difficult materials in a comfortable home setting without any of the added pressure normally associated with traditional colleges. As a result, keeping up with regular deadlines during online studies can become difficult for those students who lack strong self-motivation and time management skills. In traditional classrooms, teachers can give students immediate face-to-face feedback. Students who are experiencing problems in the curriculum can resolve them quickly and directly either during the lecture or during dedicated office hours. Personalized feedback has a positive impact on students, as it makes learning processes easier, richer, and more significant, all the while raising the motivation levels of the students.

Lack of technical knowledge. Lack of technical knowledge is also one of the main problems faced by students while taking the virtual class. Students responded with a lack of technical knowledge, which includes a lack of knowledge about software while attending virtual classes, unable to use live classes, unable to submit online assignments, etc. As many students submit their assignments in scanned copies after writing their tasks in a copy. Before this COVID pandemic, developing countries like Nepal had not started many ICT classes. Due to this COVID pandemic colleges were closed and because of this colleges are competing to conduct online classes lack of technical knowledge is one of the frequently faced problems by students during this pandemic period while attending online classes.

In contemporary times, young people and kids who were raised around mobile devices often feel very comfortable using mobile devices, and laptops and surfing the Internet. Sometimes we forget that not everybody has such great computer skills. For those, the challenge of a virtual class is computer skills. This is a challenge for teachers as well because they have to both have the know-how of the ICT class programs they are using for teaching but also have the competence to give support to students for using the programs. According to Ndzibah and Ofori, it is essential for a successful virtual class, that the student is not hindered by a lack of E-skills and computer skills. Ndzibah and Ofori remind them that technical competence or incompetence is something that should be taken into consideration while planning ICT courses (Ndzibah & Ofori, 2017).

Many of the students reported the same factors as poor internet connectivity, unstable power supply, notification distraction, security and privacy, awareness about the benefits of e-learning, resistance from students and educators to using ICT learning methods, lack of technical knowledge, shortage of gadgets, lack of quality e-content, lack of awareness, lack of foreign language skill, incompatibility of contents, high rate of illiteracy in computer and skill unavailability, attitudinal hampering, cultural barriers are the main challenges of virtual learning. These are the main challenges of virtual learning while students using it in Nepal.

Among challenges to ICT learning, the most frequently encountered were difficulty adjusting learning styles, having to perform responsibilities at home, and poor communication or lack of clear directions from the educator. Lack of physical space conducive to studying and mental health difficulties was also common. The data showed that the availability of fast and reliable internet connection was a bigger concern than either device ownership or technical aptitude. Many of the students join

their classes through their mobile phones which may not fulfill all the teaching objectives like presentations. The ICT learning methods currently practiced in education tend to make participating students undergo contemplation, remoteness, and a lack of interaction. As a result, many of the students and teachers who inevitably spend much of their time online can start experiencing signs of social isolation, due to the lack of human communication in their lives. Social isolation coupled with a lack of communication often leads to several mental health issues such as heightened stress, anxiety, and negative thoughts (Thapa, 2020).

Chapter V

FINDINGS, CONCLUSION, AND IMPLICATIONS OF THE STUDY

After analysis and interpretation of the collected data, the researcher needs to present the major finding, conclusions, and implications of the study. This chapter deals with the key findings and conclusions of the study and suggests the possible direction for further research and its implications for those concerned bodies. The findings, conclusions, and implications of this study have been presented in separate headings as follows.

Findings of the Study

Findings are the key ideas and information obtained from the analysis and interpretation of collected data. The present research study entitled "Availability of ICT Tools in Mathematics Classroom: A Case Study" was undertaken to accomplish objectives which was to find out the status of the use of ICT in Mathematics class at Dhading District and to find out the opportunities and challenges to practice of ICT at secondary level mathematics teachers and student.

The research design was qualitative case study type and conducted in purposively chosen one government school of Shree Palpa Samari Bhanjyang Secondary School of Dhading district., Nilkantha Municipality-09. To accomplish the objectives of the study, data and information were collected through classroom observation and in-depth interviews with one school Head teacher, two Mathematics teachers, and four students with two boys and two girls from classes 9 and 10 from the case school. As this study was a qualitative case study, the respondents for this study were taken purposively.

George Seimens Theory of connectivism and Piaget's and Vygotsky's Constructivist theory were used to analyze the collected data and interpret the

meaning. Cross-check, comparison and triangulation were done to analyze the collected data using the tools from the case school and respondents. After analysis and interpretation of the data obtained via classroom observation and conducting an in-depth interview with the head teacher, mathematics teachers, and students of the case school. It was found that based on the conceptual framework and analysis of this research study, the researcher categorized major findings as following sub-headings.

Availability of ICT Tools

In the classroom observation and participants interview the school had access to ICT infrastructure and had computer lab with 10 computers and other ICT tools, OHP had connected most of the classroom. ICT had not provided any ICT device to students or even teachers. ICT tools were not sufficient for all the students because the school had an excessive number of students. The school had an internet facility to search the relevant information and to do administrative digitally. For the case school the government of Nepal had not provided any technical and financial support to establish the ICT infrastructures. Both mathematics teacher used their own laptop. Because of their low economic status most of the students were incapable to have computers and other technical devices.

Opportunities of using ICT tools in Mathematics Classroom.

The effective use of ICT in teaching and learning Mathematics motivates both students and teachers. Students are taught to work in collaborative groups or apply the problem-solving when using a computer to solve a problem, and ICT is involved in developing the solution. Higher order thinking of math students consists of the transformation of information and concepts. Interactive Visualizations and Explorations when ICT use properly. ICT are most powerful when used as a tool for problem-solving, conceptual development and critical thinking in mathematic. ICT

produced a creative learning environment for teaching and learning process. There was a use of ICT in mathematics teaching and learning in the case school. It was promoted collaborative learning in a distance learning situation. Through use of ICT student were able to self-learning. ICT support teaching by facilitating entrance to course content. Most of the teachers have a favorable attitude towards ICT.

Science/Mathematics background teachers have a more favorable attitude than Arts/Social Science background teachers toward Information and Communication Technology (ICT). Use of ICT was essential for better education and including collecting quality for teaching and learning mathematics.

Challenges of using ICT Tools in Mathematics Classroom.

Researcher found various challenges while practice at secondary level mathematics teachers and students. There were availability of ICT infrastructures which were limited for the school. There was a lack of technical support when working with ICT tools. In the case of using ICT not all teachers were well trained and competent to implement ICT integration in teaching-learning. The main problem was found by researcher was unstable network and internet connectivity. School administration has less concern to motivate the teacher to use ICT in the mathematics classroom. There was only one classroom decorated with an ICT facility, that's why it's arduous to participate all students on regular basis. As the national transmission line of electricity has not connected at schools even in the Dhading district, teachers were inept to use technologies in their classrooms due to the problem of load-shedding. There is a lack of permanent technicians for solving the technical problems which appear at the time of teaching-learning using ICTs. Training organizations have less emphasis on teacher training related to ICTs integration in classroom activities.

There is no supervision for the teachers whether teacher use technologies in their classroom activities or not.

From the above findings it can be summarized that with the development of innovative technologies for teaching learning activities, the government schools of Nepal were trying to implement ICT integration in schools. The school has its computer lab and other ICT infrastructures available at school. As the school has an excessive number of students, the available tools and devices were not sufficient. School administration was using technologies to do administrative tasks digitally, and mathematics teachers were using technologies for teaching mathematics interactively, figuratively, and interestingly.

Most students want to study mathematics integrating with the advanced manipulated and animated technologies for making mathematics learning more realistic, funny, enjoyable, and interesting. Besides teachers were obligated to use such ICTs on regular basis because of several barriers like inaccessibility of infrastructures, electricity problems, lack of technological pedagogical content knowledge, lack of supervision and administrative support, lack of motivation, etc. It was also found that as most of the students were from low economic status, they were inept to have their computers and other technological devices and services at their home that's why they were obligated to live as passive learners even in this digital age.

Conclusion

This case study research tries to examine the Availability of ICT tools in Mathematics Classrooms. From the minute analysis, interpretations, and findings, the researcher concluded that as a bulky conversion in science and technology, the use of technology is indispensable for the education system. Integration of ICT in education

is a comparatively new phenomenon in Nepal like many other developing countries. The results from the review of related literature, observation, and in-depth interview with the Head Teacher, Mathematics Teachers, and students of the case school showed that the Government of Nepal initiate the introduction of ICT in education through different policies and programs, still, it is not practicing in teaching and learning at a full flow in secondary schools of Nepal. It will take some more time to ensure successful, productive, and continuous use of technologies in classroom practices because of various social, economic, and ethical hindrances. Based on the findings of the study, it can be concluded that the pedagogic use of technology has influenced by the availability of ICT tools, teachers' and student's attitudes towards it, teacher knowledge and skill, student's socio-economic status, school's leadership and administration style, community support for it, etc.

This study shows that ICT integration in Mathematics. From literature displayed several challenges and opportunities to utility ICT in mathematics. ICT integration in Mathematics-education has a positive impact on both the teaching and learning process. The study was conducted to determine the impediments to the integration of ICT in mathematics teaching and learning in Teacher-Training colleges & secondary school levels. There are some barriers to integrating ICT in teaching and learning mathematics in various branches of mathematics. Therefore, for the effective implementation of ICT integration in teaching-learning mathematics, the school administration has a clear plan to provide the technological pedagogical knowledge content knowledge to all teachers via various pieces of training, seminars, and workshops, develop the ICT infrastructures in the school coordinating with different government and non-government organization and also the GON had necessary to

take any relevant step to build the well-equipped physical infrastructures and trained, qualified human resources in each government schools of Nepal.

Implications of the Study

The Government of Nepal provisioned to implement the ICT integration in teaching-learning practices by introducing several policies and programs like the ICT master Plan (2013-17), ICT Policy 2010, ICT Policy 2015, SSRP (2009-15), SSDP (2016-22), etc. Nevertheless, most of the government schools were still incapable to implement it. Also, most of the mathematics teachers were practicing the traditional lecture method of teaching-learning without the use of any innovative technologies. So, this research study may play a significant role in the effective and efficient implementation of ICT integration in schools and mathematics teaching-learning.

There are some of the educational implications of this research study . There is no sufficient ICT infrastructures in school so for this school administration should give more concentration to build ICT infrastructures and motivating teachers to integrate technologies into their classroom activities. Student thought only class and books for study but by this research students should know there are various opportunities to learn besides classroom activities. The student's terror of mathematics should be far away because of using different types of ICT tools. Government schools should try to coordinate with different governmental and non-governmental organizations to develop their ICTs capacity in schools. The most important facts is that Mathematics teachers should improve their teaching-learning practice emphasized group discussion and child-friendly teaching-learning instead of lecture methods. There are important of ICT tools so Mathematics teachers should use technologies in their classroom activities on regular basis to make mathematics learning more interesting and interactive. Government takes role model for effective

teaching and learning so for this Ministry of Education, Science, and Technology (MEST), and NCED should encourage the teachers through organizing seminars, workshops, or pieces of training to improve their existing mug and jug method by introducing ICTs. The government of Nepal (GON), and the Ministry should launch the plan and programs for establishing ICT-friendly school activities.

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Appendices

Appendix – A

Interview Guideline for Head Teacher

Dear Head Teacher,

I am a student of mathematics education at the Central Department of Education, Kirtipur Kathmandu, Nepal. In the partial fulfillment of the requirement for the Degree of Master in Mathematics Education, I am going to do my research work entitled " Availability of ICT Tools in Mathematics Classroom: A Case Study" the rationale of this study is to access the availability of tools in the mathematics classroom and to explore the condition of application of ICT tools in Mathematics classroom. To fulfill my research study, I need some required data from the school's record related to ICT. I hope you don't feel difficulty to help me.

Name: Interview Date:

Age:

Sex:

Qualification:

Head Teacher from School Name: Type of School:

No. of teachers:

No. of Mathematics Teachers:

The interview with the Head Teacher of the case school was taken under the following points/topics.

- Brief Introduction to School
- Known / unknown about ICT
- Experience in using ICT
- Participating in any training, and workshops related to ICT
- School overall ICT infrastructures development before and after being the headteacher

- Support of any Governmental or, Non-Governmental organization for the development of ICT infrastructures
- Available tools of ICT in school
- Condition of ICT use in teaching and learning
- Teachers' competence and skill
- Problems / Challenges / Issues / Barriers to using ICT in teaching-learning
- Responsibility for effective application
- Further Planning
- Comments and suggestions about policy and practice of ICT integrated teaching-learning practice

Appendix - B

Interview Guideline for Mathematics Teacher

Name: Interview Date:

Age:

Sex:

Qualification:

Teaching Experience:

School Name:

The interview with the Mathematics Teacher of the case school was taken under the following points/topics.

- Known/unknown about ICT integrated teaching learning
- Condition of Availability of ICT tools at school and classroom
- Importance of using ICT in mathematics teaching and learning
- Teacher competency and training
- Relation between mathematics teaching learning and ICT use in it
- Role of teacher for effective use of ICT in the mathematics classroom
- Students' attraction and motivation toward leaning mathematics while using and not using ICT
- Administrative support for effective use of ICT in the mathematics classroom
- Appropriateness of using ICT in mathematics teaching and learning
- Problems / Challenges / Issues / Barriers to using ICT in teaching-learning mathematics
- Comments and suggestions about policy and practice of ICT integrated teaching-learning practice

Appendix – C

Interview Guideline for Students

Name: Interview Date:

Age:

Sex:

School Name:

Class:

The interview with the Student of the case school was taken under the following points/topics.

- Introduction
- Known/unknown about ICT
- Availability of ICT in Schools and classroom
- Access to Computers and other devices at school
- Opportunity to go to the computer laboratory
- Use of technologies by teachers in the mathematics classroom
- Perception towards ICT integration in the mathematics classroom
- Access to the internet and other technologies at home
- Administrative support for the effective implementation of ICT in the mathematics classroom
- Problems/Challenges/Issues/Barriers to using ICT in teaching-learning mathematics
- Opportunities and expectations
- Comments and suggestions

Appendix - D

Class Observation Guide

Name of School:

Name of Teacher:

Date:

Subject: Topic:

Name of Observer: Duration of Class:

Observation Checklist for classroom observation under the following topics/points:

- What technologies and tools are available in Schools and classrooms?
- What technologies do teacher use in the classroom?
- What mathematical software or, program is available and used by the teacher in the class room?
- How does a teacher make students involved with technology?
- How do students respond in class?
- The ability of teacher to combine ICT and mathematical lessons
- Provided opportunity for learners to use ICT as a source of learning
- Are students attentive in the classroom or, are they misusing the technology?
- What method or, methods teachers are using in the classroom?
- Reliability of using ICT according to lesson
- Are there any challenges faced by the teacher to implement ICT in classroom teaching and learning?
- Recommendations