

**ICT IN THE PROFESSIONAL DEVELOPMENT OF MATHEMATICS
TEACHERS: A NARRATIVE INQUIRY**

**A
THESIS
BY
SUJAN SAPKOTA**

**IN THE PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE
DEGREE OF MASTERS OF EDUCATION**

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शिक्षा शास्त्र केन्द्रीय विभाग
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Letter of Certificate

This is to certify that Mr. Sujan Sapkota, a student of the academic year 2074/75 BS with thesis number 1756, exam roll. **7328467** Campus Roll.274, T.U. Reg. 9-2-278-1014-2012 has completed his thesis during the time prescribed by the rules and regulations of T.U. Nepal. This thesis entitled “**ICT in the Professional Development of Mathematics Teachers: A Narrative Inquiry**” embodies the result of investigation conducted during the period of December 2019 to April 2022 at the department of Mathematics Education, University Campus, Tribhuvan University, Kirtipur, Kathmandu. I hereby recommend and forward that his thesis be submitted for the evaluation for the evaluation to award the Degree of Master of Education.

Date: 6th November, 2022

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Letter of Approval

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Thesis

By

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Entitled

“ICT in the Professional Development of Mathematics Teachers: A Narrative Inquiry” has been approved in partial fulfillment of the requirement for the Master Degree of Education.

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Recommendation for Acceptance

This is to certify that Mr. Sujan Sapkota has completed his M.Ed. Thesis entitled “**ICT in the Professional Development of Mathematics Teachers: A Narrative Inquiry**” under my supervision during the period prescribed the rules and regulations of Tribhuvan University, Kirtipur, Kathmandu, Nepal. I recommend and forward his thesis to the Department of Mathematics Education to evaluate in the final viva-voce.

Date: 6th November, 2022

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Asst. Prof. Krishna Prasad Adhikari

(Supervisor)

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Declaration

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

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Sujan Sapkota

Dedication

Honestly dedicated to my father Mr. Madhu Sudan Sapkota and my mother Mrs.

Sushila Sapkota who play the important role in my life.

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First of all, I would like to express my heartiest thanks and very sincere gratitude to my respected teacher Mr. Krishna Prasad Adhikari , Department of Mathematics Education, T.U. who provided fundamental ideas and techniques to carry out this research, as a supervisor. Without his immense co-operation and regular encouragement, I would not have been able to present this dissertation in this form.

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Sujan Sapkota

Abstract

The integration of information and communication technology (ICT) has become essential in teaching learning process especially in mathematics teaching. The research entitled "ICT in the Professional Development of Mathematics Teachers: A Narrative Inquiry" proposed to dig out the praxis of ICT on the professional development of mathematics teachers and to explore the role of ICT in the professional development of mathematics teachers. I followed the narrative inquiry research design under the qualitative research method. I prepared the in-depth interview schedule to collect authentic data for my research. The interview was conducted with four mathematics teachers selected by purposive sampling strategy to make data more valid. In this research participant's narrations helped to find out the perception of teachers towards the role of ICT on teacher professional development (TPD). This research was done in Sindhupalchok district. I interpreted and analyzed the collected data with the different themes.

Findings showed that different ICT tools helped to develop the professional skills of the mathematics teachers. In the teaching and learning process, teachers can use different tools like, the internet and computer, videos, mathematical applications (e.g. GeoGebra) etc. which also make them updated on the basis of changeable time. Different ICT tools can create problems for the teachers, it takes time to prepare and use and takes more economy. Teachers also have an important role to reduce the negative effect of ICT. Although the software is very beneficial for teaching in everyday sessions, it is highly expensive to purchase, and it takes more time to learn how to use it. It was discovered that mathematics teachers in the Sindhupalchok area improved their professional growth after using various tools and software available on the Internet. Different stakeholders have to play the role to increase the effectiveness of ICT on the professional development of mathematics teachers.

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Appendix

List of Abbreviation

BPEP	: Basic and Primary Education Project
CERID	: Research Centre for Educational Innovation and Development
CPD	: Continuing Professional Development
CT	: Crucial Tool
CUP	: Cambridge University Press
E- Learning	: Electronic Learning
ICT	: Information and Communication Technology
IEMIS	: Integrated Educational Management Information System
M- Learning	: Mobile Learning
MSN	: Microsoft Network
OHP	: Over Head Projector
S.N.	: Serial Number
SNS	: Social Network Site
T.U.	: Tribhuvan University
TALIS	: Teaching and Learning International Survey
TETPD	: Technology Enhanced Teacher Professional Development.
TPD	: Teacher's Professional Development

Chapter I

INTRODUCTION

The first chapter of my research includes the background of the study, statement of the problem, justification of the study, objectives of the study, research questions, delimitation of the study, and operational definition of the key terms.

Background of the Study

The teacher professional development is now a developing area in teacher education. There are different models that are in practice for this purpose. In this age, scientific process tends to nation's process. In developed countries, the output acquired by the nation in the math is appraisable but any developing country is not able to get required output (Pandey, 2011). The world is being taken over by the storm of the twin forces of Globalization and technological changes. The past fifteen years have seen a new global economy being created which is “powered by technology, fueled by information and driven by knowledge” (Tinio, 2002). Education and training sector has a major role to play in the implementation of the proposed ICT policy.

Teachers have a major role to take the new technology to the classroom and use it in making teaching and learning process more interactive and enjoyable hence more effective. Kenya(2006) argued in most developing countries lack of ICT infrastructure and the teachers have not obtained appropriate training to enable them to use ICT in pedagogy unlike their counterparts in developed world who are using ICT to conduct collaborative or interactive teaching learning suited to digital environment. These developing countries have realized that the only way they can narrow the economic gap between them and developed countries is to narrow the digital divide by providing ICTs in Education and training the teachers adequately to

be able to integrate ICT in learning. An assistant minister in the ministry of education has told Kenyan members of parliament to embrace E-learning in their constituencies because by so doing, they will improve the performance of students since ICT makes learning easy and interesting (Ratemo, 2011). Professional development of the teacher is the long life impressive factors to promote mathematical knowledge. In this research I tried to explore the praxis of ICT on professional development of mathematics teacher with using ICT, which helps to increase the percentage of passed students in mathematics. Teacher should be imaginative, innovative, communicative, commanding, competent, confident, courageous, critical and creative.

Professional development on the job may develop or enhance process skills, sometimes referred to as leadership skills, as well as task skills. Professional development opportunities can range from a single workshop to a semester-long academic course, to service afford by a medley of different professional development providers and varying widely with respect to the philosophy, content, and format of the learning experiences. The professional development of teacher is life long process which begins with the initial preparation that teachers receive and continuous until retirement (Acharya, 2011). The modern age of science and technology demands creative, dynamic as well as multi dynamic and multimedia approach. Teachers as professional continually receive knowledge on the job because their work entails engagement in a succession of cases, problems or projects and need to consult many other teacher reference books which are the sources of teachers' knowledge in his or her professional education (Sharma & Shrestha, 2013).

Statement of the Problem

In this technological world ICT has crucial role on teaching and learning field. There is little research importance of ICT on teaching and learning field. There also

few research on advantages and disadvantages of ICT of teacher professional development. In our Nepali context there are very few research related on ICT and its relation to mathematics teachers' professional development. ICT integration in mathematics education provides mathematics teachers with integrative teaching methods that motivate students learning, support their independent learning and active participation in the discovery of mathematics concepts. In my research I try to find out praxis and the role of ICT on professional development of mathematics teacher from mathematics teachers' perceptions.

I chose this research topic because previous research studied on: teachers' perceptions of their ability in ICT, teachers' attitudes towards ICT contribution to the mathematics teaching, teachers' attitudes towards ICT contribution to students' mathematics learning, teachers' emotions towards the use of ICT in the mathematics classroom, teachers' feelings of self-esteem and control in the presence of ICT in the mathematics classroom, teachers' intentions to actually integrate ICT in their teaching and role of ICT on the professional development of the mathematics teacher. But there are some areas where researcher cannot go in deep till now. So, I came to choose this topic for my research.

Justification of the Study

In this technological world it is necessary to follow the ICT on teaching and learning field. In our Nepali context, different academic institutions and non-academic institutions are using ICT to increase the quality of the works. In teaching-learning field it has important role on students learning, teachers' professional development, because it easily provides the academic and non-academic knowledge too. The integration of ICT in the teaching and learning of mathematics, as a result of ICT educational affordances, helps students have better achievement in mathematics. ICT

is a crucial tool that teachers can use in teaching powerful and critical mathematical concepts. Guoyuan, (2010) this would enable learners to get insight and proper comprehension of the concepts and apply them in problem-solving. It is also notable that development in almost all aspects of life depends on efficient knowledge of Mathematics and science.

Teachers can get ideas about ICT, its advantages and disadvantages, impact and role of ICT on their professional development. By participating in mathematics professional development activities teachers can be made aware of new ideas to enhance their practice, knowledge and understandings so they can ultimately improve the learning outcomes of students in their classes. Teacher professional development can enhance pedagogy and teacher knowledge. Students from different levels can get ideas about the importance and advantages of its on learning in this technological world. The principle would be beneficial to use ICT and manage of it on teaching-learning process at school. This research also be effective for school inspector, to evaluate schools to ensure that specific standards mathematics teacher and for teachers to use the effective ICT tools in teaching and learning process.

Objectives of the Study

The objectives of this study are:

1. To dig out the praxis of ICT in the professional development of mathematics teachers.
2. To explore the perceptions of mathematics teacher in role of ICT in teacher professional development (TPD).

Research Questions

1. What roles can ICT play in the teacher professional development of the mathematics teachers?

2. What challenges and opportunities are raised on use of ICT in professional development of mathematics teacher?
3. How mathematics teachers perceive the role of ICT in professional development?

Delimitation of the Study

This study was delimited to:

-) Four math teachers who have 7 years of teaching experience and have participated TPD training program of Sindhupalchok district were selected as the sample by using purposive non-random sampling strategy.
-) Similarly in-depth interview and informal conversation were used as a tool for collecting data and informing.
-) The collected data from the participants were analyzed by using thematic analysis.

Operational Definition of Key Terms

The key terms that the researcher used in this study can be enlisted below with their contextual meaning;

Professional development. Professional development means the development of teaching skill, classroom management skill, communication skill, innovative skill, and technological skills of mathematics teachers by using ICT.

Teachers. Teachers teaching Mathematics at secondary level of public school.

Information and Communication Technologies (ICT). ICT refers to technologies that provide access to information through telecommunications. This includes the Internet, wireless networks, cell phones, and other communication mediums.

Praxis. Praxis refers to the practice of ICT tools for the professional development of mathematics teachers.

Smart Classroom. Smart class means use of computers, projectors, internet, and mathematics software like geogebra for teaching mathematics.

Chapter II

REVIEW OF RELATED LITERATURE AND CONCEPTUAL FRAMEWORK

The review of literature provides the researchers with a strong knowledge base to find out the area of problem and the need of investigating on it. Similarly, for setting the objectives of the study and to conduct appropriate methodology for the study, literature reviews plays vital role.

In this chapter includes the review of theoretical literature, review of empirical literature and implication of the literature review.

Review of Theoretical Literature

Constructivism

According to constructivism, learning is the process to construct new knowledge and understanding, for this cognitive pedagogy is essential and prior knowledge is needed for constructing new knowledge (Driver, 1994). In this process of learning, the learners gain knowledge and meaning from their own experiences. In the process of knowledge construction, active role of learner in the environment plays the significant role. This view held by constructivist on their nature of knowledge but most influential in the process of human learning are work of Jean Piaget, David Ausubels and Lev.Vygotsky.

Teacher professional development is defined as teachers' learning: how they learn to learn and how they apply their knowledge in practice to support pupils' learning. It is argued that courses and lectures, or 'times for telling', and teachers' development of a met cognitive attitude are decisive factors for teachers' learning within a constructivist frame of reference (Posthlo, 2012).

(Vygotsky, 1978) was famous scholar who emphasize on the social constructivism. It is also focused on the roles that societies play in the development of

an individual. This theory believes that people learn everything on two levels: first through interaction with others and then integrate into the individual's mental structure. Investigation develops a usually deep understanding of the important of past experiences and prior knowledge sense of present experience and new situation. He comes to the understanding that all new knowledge and newly introduced skills are, the highest degree influenced by each students social surrounding especially life in insufficient. It is necessary to change an individual social surrounding in order to change the person (Hodso & Hodson 1998).

The review of constructivist theory shows that both individual and organizational factors impact teachers' learning. Teacher co-operation has importance for how they develop, and some of the teachers can lead such learning activities themselves. Moreover, a positive school culture with a good atmosphere and understanding of teachers' learning, in addition to co-operation with external resource persons, may impact the professional development of teachers and learning in school is the best arena for further development of teachers.

Review of Empirical Literature

Benning, (2019) conducted the research on "Professional development for using technology in mathematics teaching Ghana". This study set out with two aims. First, shifts in teachers' technology dispositions (beliefs, attitudes, and knowledge) were explored after engagement in the professional development program mediated with GeoGebra software. Second, typical features and nuances of the complexities of enacting effective mathematics pedagogy in a GeoGebra learning environment were examined. Self-report questionnaire, interviews, focus group discussions, lesson plans, and lesson observations were used for data collection and 11 in-service mathematics teachers from a senior high school in Ghana were engaged in a

professional development programmed for 12 months. The results provided evidence that within GeoGebra-based mathematics lessons, teachers were able to enact, to different degrees, five practices central to effective mathematics pedagogy: creating mathematical setting, providing useful mathematical tasks, orchestrating mathematical discussions, making mathematical connections, and assessing students' learning. Further analysis of the data provided evidence for theorizing 31 core practices across these central themes of effective mathematics pedagogy. Following their engagement in the professional development, the teachers enacted these practices to greater or lesser extents. However, it was problematic for most teachers to effectively engage their students in deep mathematical discussion.

Nansone and Dudareva, (2014) studied on "Teacher's continuous Professional development and uses of ICT in teaching/learning process. Achievement of information communication technology (ICT) skills has become an integral part of the contemporary teaching/learning process. Ten years of experience of the Center for Science and Mathematics of the University of Latvia working in the field of teacher professional development shows that the teachers who have successfully mastered their ICT skills during teaching/learning process have accomplished several professional development stages since 2005. The first stage includes acquisition of various ICT usage tools, as well as identification of the resources available for the organization of the teaching/learning process in science and math. The second stage addresses development and enhancement of ICT skills for organization of the teaching/learning process and engagement of students with the content. The purpose of the research is to observe ICT usage in the science and math teaching/learning process in a real classroom environment and to develop the next stage teacher continuing professional development (CPD) model according to the current needs.

Lesson observations indicate: 1) limitation in ICT usage; 2) the need to create a next stage CPD training model, where teachers will be able to design their own lessons with purposeful application of ICT tools and resources in the teaching/learning process.

Blanchard, Leprevost, Deel Tolin, and Gutierrez, (2016) studied on "Investigating technology – Enhanced Teacher Professional Development in Rural, High-Poverty Middle School" Mixed-methods study investigated the effects of teacher technology-enhanced professional development (TPD) on 20 teachers' beliefs and practices. Teachers in two middle schools located in neighboring rural, high-poverty districts in the southeastern United States participated in reform-based lessons and learned how to integrate technologies into their teaching over three summers and throughout the school year. Mathematics and science assessment scores for 2,321 students both with and without TPD teachers were analyzed over the 3 years of teacher TPD. Teachers' reform-based teaching beliefs and their comfort using new technologies increased significantly, and all of the teachers integrated the use of technologies into their instruction. Although some TPD teachers used technology in ways that transformed their roles and classroom practices, the majority of the teachers adopted technology in ways that improved efficiency and effectiveness. African American students who had more TPD teachers over more years experienced significant gains on end-of-grade mathematics and science tests. Findings suggest that if teachers integrate technology into their instruction, large-scale changes in teachers' practices are not necessary to enhance students' learning, particularly for African American students.

CERID, (2003) the educational research center under Tribhuvan University did a research on "transfer of training skills in the classroom delivery" during basic and

primary education project (BPEP) in 2003. The main objective of the study was focused on the delivery part of the training and transfer of the training skills in the classroom delivery which was prioritized by second phase of BPEP. Classroom observation was done in order to get insights into the transfer of training in classroom delivery and the focused analysis of classroom observation was undertaken with respect to the classroom delivery skill and mentioned in the primary teacher training manuals. The study identified trainers' quality, availability of materials, and activities during training, training delivery skill in TOT as the major factors that affect delivery of training.

Bistha ,(2011)conducted a research on the topic "Transfer of Training Skills in the Classroom delivery at Primary Level Mathematics Teaching" which was submitted to the department of mathematics education, TU. The main objectives of the study were to analyze the current status of transfer of primary teacher training skills in the actual classroom and to find out the supporting and inhibiting factors to training transferring the classroom delivery. The study is case study and the research is descriptive and qualitative in nature. Sampling done is purposive in which selection of sample depends entirely on the researcher's convenience. The research toots used is classroom observation checklist and structured interview questions. The researcher has conclude that the training process has not succeed to bring out realization among the trainee teachers and transfer of training skills in the classroom delivery is negatively affecting in case of absence of monitoring and supervision from DEO.

Chao.GM, (2015)did a study "Impact of Teacher Training on ICT Integration in Public Secondary School in Mombasa Country" with the objective to investigate whether, teacher's training in ICT has an impact on integration of ICT in schools and to find out how effective the ICT training received by teachers is, in assisting them to

integrate ICT in their work to make it more interactive, interesting, and innovative. Even though there is a shortage of ICT infrastructure in most schools in Kenya, the biggest problem is that, even in the few schools with adequate infrastructure, teachers lack the necessary training to enable them to use the facilities to enhance learning. 88% of the respondents in this research indicated that they have computers in schools. Teacher ICT training is haphazardly done due to lack of policy and standards.

Kiru , (2017)had piloted a study entitled on "Mathematics Teachers' Use of ICT: An International Comparison" with the purpose of understanding the extent to which mathematics teachers use ICT across the sampled countries, to examine differences in professional development needs between mathematics and non-mathematics teachers, and examining the factors that predicted ICT use. Understanding the frequency of ICT use can shed light on areas that need continued research, such as examining the trends of ICT use in mathematics instruction among teachers and across countries. Additionally, in an effort to understand how teachers use ICT, there is a need to investigate the various factors that may impact ICT use in content areas such as mathematics. This study offers an international perspective that focuses on eight countries using the Teaching and Learning International Survey (TALIS) 2013 dataset to investigate frequency of ICT use, and examine factors that may have contributed to teacher's ICT use in mathematics instruction. This analysis shows limited ICT use in mathematics instruction and differences in ICT use among the countries. Teacher cooperation, mathematics self-efficacy, and professional development in ICT skills were significant predictors of ICT use. Implications for research and policy are discussed.

Niekeker and Blignaur, (2014)conducted study "A Framework for ICT integration in schools through TPD". According to the study the demands of the

twenty-first century require effective and sustainable use of Information and Communication Technologies (ICTs) in education. Various ICT strategies and initiatives across South Africa have not resulted in system-wide, sustainable ICT integration in schools. Although the roles of principals are acknowledged in educational management, the question remains how principals influence teachers' effective and sustainable integration of ICT through teacher professional development (TPD). A matrix of theoretical criteria selected seven participants across diverse contexts. In-depth interviews produced an integrated dataset that revealed principals' patterns of influence, their perceptions and experiences, their leadership and management styles, their attitudes towards ICT integration, their knowledge on related ICT and related TPD issues, as well as their strategic thinking on ICT integration. The proposed theoretical framework illustrates the interrelatedness of aspects that influence principals' leadership through open distance learning.

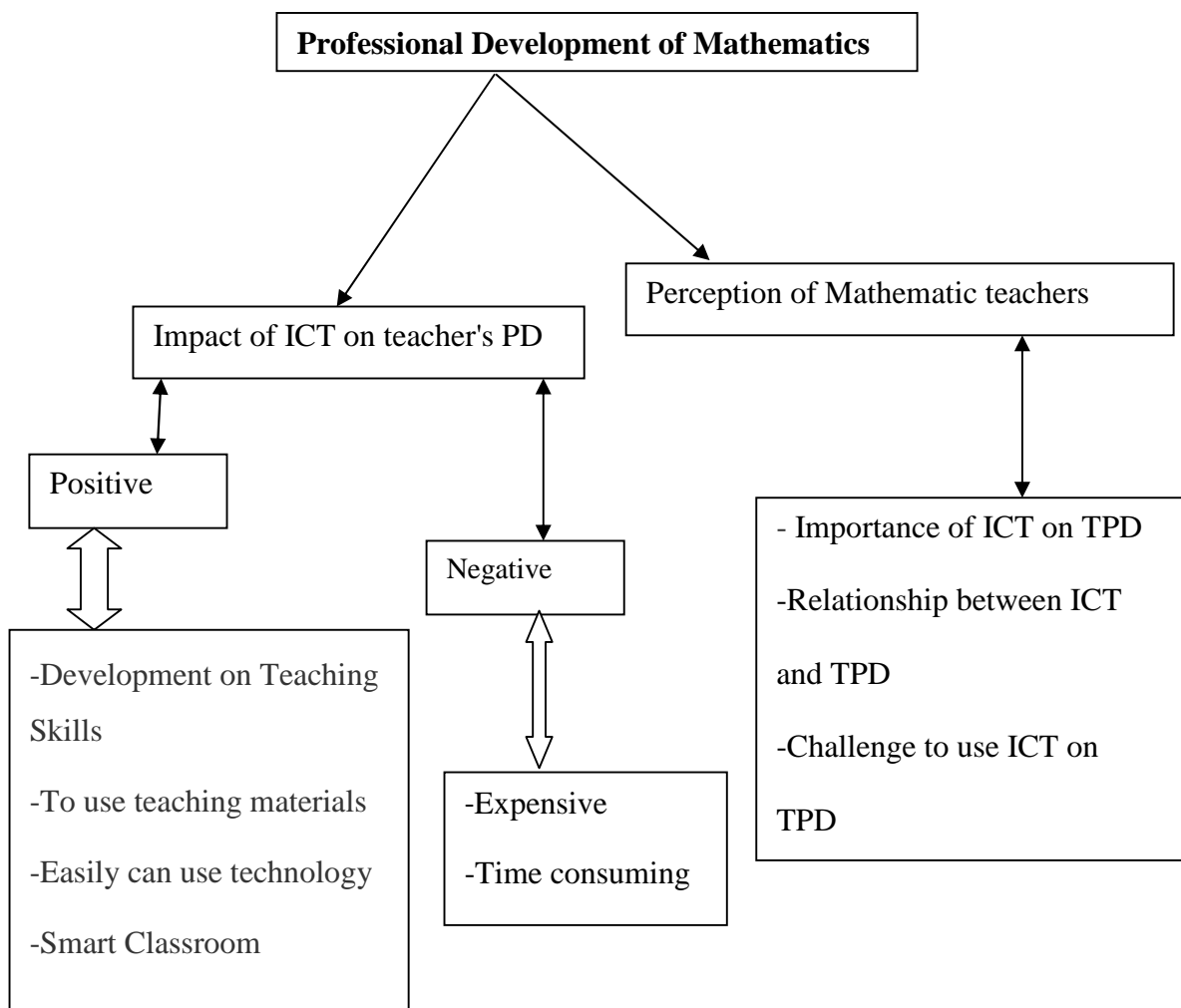
Research Gap

Information and communication technologies rule the day and age. ICT tools are being used extensively in math education by many mathematics teachers. It has also been demonstrated that ICT tools are crucial for the growth of students on mathematical learning capacity. Numerous innovative mathematical inventions and tools are being used in the teaching and learning sector. ICT tools, various software for teaching mathematics, and use of ICT tools for teacher professional development are topics that are being discussed everywhere. In the developing country like Nepal there is no long history of use of ICT tools in mathematics teaching and learning activities. I studied and evaluated a lot of literature regarding the use and important of ICT tools for teacher and professional development and teaching and learning activities. I discovered that they are doing research on using ICT on teaching,

important of TPD and ICT integration in schools through TPD, etc. So that, in this research, I explore the praxis and role of ICT and ICT tools in teacher professional development of the Nepali mathematics teacher. So, I am quite excited to study on this topic.

Conceptual Framework

Conceptual framework had been developed as per the objectives of the studied, I would had a Narrative inquiry in represents the mathematics teacher by used problem solved approached in teaching mathematics, the following chart shows the framework by which I would conducted the field of studied. This following chart was constructed with the helped of previous researched and studied carried out ICT in professional development of mathematics teachers who had 7 years of experiences on teaching mathematics by using ICT:



[Figure 1: ICT in the professional development of mathematics teachers]

Implication of the Review for the Study

Review of theoretical and empirical literature play a vital role for the success of any research study. It helps the researcher from the beginning to end. It provides insights about the objectives, research questions, methodological procedure and other important aspects of research. That is to say, it helps researchers to bring the clarity and focus on research problem, reform methodology and contextualize the findings. In order to accomplish this research study the researcher also reviewed some research works that were already carried out. These researches helped the researcher to find out the topic as well as the gap between what has already existed and what is still there to be found.

In the process of reviewing theoretical literature, the researcher has gone through different books, articles, and journals. Similarly, the researcher has reviewed much empirical literature which is very similar to proposed study. I gained also of ideas for my research after review the lot of research. Tinio(2002), Pandey(2011), Acharya, (2011), and Sharma & Shrestha, (2013) produced the study that helped me to get lots of knowledge for my research. Posthloim (2012) and Driver et al. (1994) provided the theoretical knowledge for mu research. Benning, (2019)Nansone & Dudareva, (2014),CERID, (2003), Bistha(2011),Chao.GM, (2015),Gu, Jianali, Wang, & Jia(2012)and Niekeker & Bliгнаur(2014), etc. assist me in deciding on my research objectives, research questions, and techniques, as well as the design. Their discovery allows me to identify a gap in the literature.

Chapter III

RESEARCH METHODS AND PROCEDURES

Qualitative research is the collection and analysis of non-numerical data such as text, video, or audio in order to better understand concepts, opinions, or experiences. It can be used to get in-depth insights into a topic or to generate new research ideas. Narrative inquiry is a form of qualitative research method. Researchers study how narratives are delivered in order to better understand how participants interpret and make meaning of their experiences. In my research, I have selected narrative inquiry research method to collect the data.

This chapter includes research design, population, sample and sampling strategy, research tool, source of data, data collection procedures, data analysis and interpretation procedure, and ethical considerations.

Research Design

Leedy, (1997) defines research design as a plan for a study, providing the overall framework for collecting data. For Durkheim (2004), research design is a strategic framework for action that serves as a bridge between research questions and the execution, or implementation of the research strategy. Research design helps to make the research systematic. If the researcher is unknown about the research design, his/her research cannot get the authentic data and conclusion. Indirectly, it takes place from topic selection to conclusion.

A narrative research is designed with a research plan which describes the real life practices of people, narrate their experiences and collect and retell their stories related to the research issue Creswell,(2011)It focuses primarily on one person, acquiring data through the collection of tales, documenting individual experiences, and determining and debating the meaning of those experiences for the individual. It

focuses on the micro-analytic picture of individual stories as opposed to the larger image of cultural norms and abstract theories. It is often employed when people are ready to tell their tales and the researcher wants to report on them because they are important. In my research study, I used narrative research design and focus on the participants' perceptions and practices regarding the role of ICT in TPD.

Throughout the interviews and other data collection processes, I encouraged participants to share their own stories and experiences. I organized their experiences and stories in chronological order after gathering them through a series of interviews. I narrate them in order to develop deeper into their characteristics, attitudes, and practices regarding mathematical inquiry and teachers' empowerment. I retell their stories and also codified the theme building.

Study Area

Every study needs study area. The study conducted in secondary schools of Indrawati Municipality, Sindhupalchok district. I selected four mathematics teachers who are teaching mathematics by using ICT at public schools. Participants were selected purposively who has 7 years of experiences in teaching mathematics with the help of different ICT tools.

Data Collection Tools

The tools are the effective means for data collection. The data collection tool is one of the important factors of the research study because it has the main role to gain authentic data from the sample populations. The research tools must be valid, reliable and economic so that the data obtained from the tools should be valid and reliable and gives actual information. In this study, I conducted a set of in-depth interview as a tool of data collection. I also developed the interview schedule for mathematics teachers. According to my research, I chose the four teachers from the

government schools who has 7 years of teaching experiences on mathematics by using different tools and technology.

Selection of Respondents

For participants A, I went to the Rajeshwori Secondary School. He is a mathematics teachers who is teaching mathematics by using different ICT at this school. I selected him because he has more than 7 years of experiences in teaching mathematics with the help of different ICT tools. All the participants were from the Indrawati rural municipality, Sindhupalchok.

For participants B, I went to the Bhimeshwori Secondary School. She is a mathematics teachers who is teaching mathematics by using different ICT at this school. I selected her who has 8 years of experiences in teaching mathematics with the help of different ICT tools. All the participants were from the Indrawati rural municipality, Sindhupalchok.

For participants C, I went to the Chandeshwori Secondary School. He is a mathematics teachers who is teaching mathematics by using different ICT at this school. I choose him with keen interest who has more than 9 years of experiences in teaching mathematics with the help of different ICT tools. All the participants were from the Indrawati rural municipality, Sindhupalchok .

For participants D, I went to the Setidevi Secondary School. She is a mathematics teacher who is teaching mathematics by using different ICT at this school. I selected her excitedly who has got 7 years of experiences in teaching mathematics with the help of different ICT tools. All the participants were from the Indrawati rural municipality, Sindhupalchok

Data Collection Procedure

First of all I visited the four schools of Indrawati rural municipality, Sindhupalchok which were selected for my research. After that I connected the mathematics teachers of those schools. I went to the field with the questionnaires which were prepared to collect the data. The data were collected under the ethical permission of mathematics teachers. The participants for this study were selected by follow purposive sampling strategy. I took the permission of all participants and make them able to know about my study. Then I took the interview with the four mathematics teachers from the four different schools by using the different ICT tools. I recorded all the response of participants on my mobile phone. And I listen it carefully then translated the whole interview. Translated data were read, re-read, codify and make the different themes on the basis of the response of the participants.

Data Analysis and Interpretation Procedure

I followed the qualitative research design, narrative inquiry to find out the role and praxis of ICT in professional development of mathematics teachers. Narrative analysis is a powerful qualitative research tool. Narrative analysis provides researchers with detailed information about their subjects that they couldn't get through other methods. I took the interview with the participants with the interview set. I recorded all the audio of the interview and narration with participants. Then I listen and re listen the audio collections. After that I translated the data from Nepali to English as responded by the participants. I read and re-read the whole data after translated. I also codified the data and find the different themes. At last I analyzed the whole collected data from the participants. At last interpreted the data thematically.

Ethical Consideration

Ethical Considerations can be specified as one of the most important parts of the research. Chetty, (2016) This requires values like accountability, trust, mutual respect, and fairness among all the parties and participants involved in a study. I informed participants about my research and importance of their response on my work. Then I took permission on every step of the data collected from the participants. I used pseudo-name because they did not want to flash their name too.

Ethical consideration helps research study to avoid the possibility of causing harm to participants, to maintain the confidentiality, avoiding biasness, preventing incorrect reporting, avoiding inappropriate use of information, preventing the misuse of information and so on.

Chapter IV

ANALYSIS AND INTERPRETATION OF DATA

A central part of the research is the analysis and interpretation of the findings.

I classified the data into various headings and subheadings for thematic analysis.

In this chapter I included the data analysis and interpretation of data.

Section I: Praxis of ICT on Professional Development of Mathematics Teacher

The purpose of teacher professional development is to improve the students' learning achievement and whole education. One of the key variables in how teachers use classroom methods is the professional training and development process.

Teachers can successfully implement a variety of instructional approaches in the classroom if they have a strong professional background and knowledge base.

Numerous studies have revealed a connection between instructors' educational practices and their professional development.

Development of teaching skills. The ICT educational programs provide a new framework that fosters improving of the teaching and learning practices in teaching mathematics. By using the different technologies like computer, calculator, different apps, etc. teacher can use different teaching strategy and methods which helps to make teachers skilled on different teaching strategy.

In this regard, respondent A said; *I use ICT for material development outside of the classroom and inside the classroom when teaching. Teacher can choose an efficient teaching strategy, complete project work, and take action using a computer. I use other tools, such as Hypatia, to construct the math questions. Use of ICT for content creation both within and outside of the classroom while educating. Varieties of notations, formulae, symbols, figures and graphs are available in mathematics which are really difficult to demonstrate in blackboard/whiteboard like*

2D and 3D figures, graphs and chart, transformation of objects and other associative matters

Similarly, respondent B stated; *I use GeoGebra and a math pad for teaching mathematics to the students. When I utilize a computer and a phone to teach, the students are more engaged in the lesson. Different ICT tools compel me to teach through the different strategies and methods. I show the videos related to the lesson and give the same problem to them and give the opportunity to solve. And I use quite different strategy when teaching through the power point.*

In the similar sense, respondent C shared; *Teachers can gain knowledge of the many mathematical figures and images by using Geogebra and different software related to the math. Using various software, teachers find it simple to create math questionnaires for the students, giving them the chance to study the subject quickly and easily. I use GeoGebra, mathematica and different software for teaching.. I also can learn about the different mathematics figure and pictures. I feel easy to make the questionnaires of math for the students by using different software.*

Likewise, respondent D articulated; *I use 3D of GeoGebra as the teaching materials which make my classroom more effective. Different technology like, YouTube, mobile, calculator, and classroom help me to conduct my classroom in the easy and attractive way. Students become more active by when I teach through the different ICT tool rather than other teaching materials. I found ICT to be useful for teaching as well as for personal and professional work. Application of ICT in teaching makes teaching more innovative, interesting, interactive, easy and effective. It complements the traditional teaching learning process.*

The above collected data from the participants it claim that different ICT tools like *GeoGebra*, *Mathematica*, *power point*, *YouTube* videos and internet help

teachers to improve their teaching skills because they use different strategies to teach mathematics by using different ICT tools. Different teaching skills help to increase their professionalism and provide the lots of information about various teaching skills and different technologies. Teachers can employ a variety of teaching strategies and approaches by utilizing different technology, such as a computer, calculator, various apps, etc., which helps to develop their expertise in various teaching strategies.

Teachers can create the math problems using Hypatia and other tools. Participants assured that by using GeoGebra and other math-related applications, teachers can learn about the many mathematical figures and graphics. Teachers may simply design math quizzes for the students using a variety of applications, providing them the ability to study the subject swiftly and efficiently.

Constructivism is the theory that says learners construct knowledge rather than just passively take in information. ICT changes the role of teachers and compel them to construct different skills and strategies to teach mathematics. It helps teacher for their professional development and motives the learners towards learning by providing various teaching learning material. ICT is the vast resources of knowledge and information. In teaching learning field ICT plays the very positive and important role but sometimes it can be a problems for the school, students, teachers, parents or all stake holders for the teaching learning activities. According to (Helen and Daminabo, 2013)ICT can present issues in the sphere of teaching and learning at times. Technology helps teachers create abstract concepts so they can build on students' past knowledge, talents, and skills, make connections to the materials' mathematical principles, resolve frequent misconceptions, and introduce more complex concepts.

Help to use teaching materials. ICT tools for teaching and learning cover everything from digital infrastructures such as printers, computers, laptops, tablets, etc., to software tools such as Google Meet, Google Spreadsheets, etc.

Participant A shared his view; *Student see only 2D materials before using the ICT in teaching and learning activity. Now days I use YouTube, smart board and math pad as the teaching materials which help to make teaching and learning activity more effective. Different training help me to use various technologies and teaching materials. Students can use ICT as a tool to perform calculations, draw graphs, and help solve problems. The most obvious example of using ICT in this way is when students use a calculator or something like that to perform more challenging numbers.*

Participant B stated; *before teaching without ICT I was unable to use different technologies and internet. Now a days I am teaching by using the various ICT tools and I am component to use it too. ICT help to teach at secondary level to use Trigonometry and menstruation, to develop the teaching material and to use the teaching materials in the effective way in teaching math. Applications of general math concepts include drawing a triangle, cube, and measuring a distance in the real world while applying Excel's tools.*

Participant C expressed; *I get knowledge and develop the digital materials by using the GeoGebra and math pads. It also help to construct the triangle and parallelograms and prove its related theorem. It implies that utilizing various ICT tools in education aids in improving learning outcomes. However, spreadsheets, computer algebra systems, or graphical calculators can be used to solve problems by tests and improvement or retrieval methods. Students of mathematics can use graphical calculators or graph plotters instead of algebra to graphically solve an*

equation.

Participant D highlighted; *I am a math teacher of class ten. Most of the case people said that math subject is difficult subject. On the basis of my class I can say that different teaching materials like youtube, mobile phone, computer, website, videos, smart board, etc. has the great role to increase the teaching learning achievement of the student. Different ICT tools increase my materials using capacity and materials building ability too. It encourages me to use ICT in teaching Mathematics. The majority of the time, individuals claims that math is a challenging subject. Different teaching tools, such as YouTube, mobile devices, computers, websites, videos, smart boards, etc., play a significant role in improving student learning outcomes and make teachers competent to use different materials also.*

From the above narrative responses of participants it stated that in this technological world ICT tools are necessary in teaching and learning process. These tools are good for students as well as for teachers, because tools also make teachers knowledgeable to use the various teaching materials. The new digital ICT is a collection of hardware, software, multimedia, and delivery methods rather than a single technology. ICT enables the creation of digital resources such as digital libraries, which allow students, teachers, and professionals to access study and course material from any location at any time.

ICT use in mathematics include: portables, graphic calculators and computerized graphing, specialized software (Google sketch-up, Geo-Gebra, Microsoft Mathematics etc.), spreadsheets and databases can be as a tool. The utilization of numerous teaching tools and techniques that encourage students to interact with mathematical ideas might be beneficial for math students. According to (Dhital, 2018), ICT in Education means teaching and learning by the use of ICT is currently

being used in education to assist students to learn more effectively by providing teachers with access to a wide range of new pedagogy. Specifically mathematical educational software GeoGebra, Microsoft mathematics, MS excel and many others can be used in teaching mathematics as teaching aids. These educational software to students offer a much better visualization, dynamism, and opportunity for independent learning, and their knowledge by searching the Internet.

Help to use technology. Technology cannot be effective in the classroom without teachers who are knowledgeable about both the technology itself and its implementation to meet educational goals. While technology use in the classroom is increasing, improving learning through its application should remain the goal. ICT provides teachers with opportunities to capitalize on the idea that it can help students visualize mathematical ideas and concepts.

Participant A said; *Since 5 years I am teaching mathematics by using different technology which help me during the Covid-19 pandemic also. In pandemic I used Microsoft office, Zoom, Google classroom, etc. to teach the students from home. I become perfect to use GeoGebra and math pad in teaching and learning activities. ICT was essential to teaching in the Covid-19 pandemic. Microsoft Team is used. The teaching and learning process is ongoing in every circumstance, as seen on zoom, YouTube, etc. Teachers are given the chance to perform their use of GeoGebra and math pads in instructional activities.*

Participant B shared; *I am strongly agreed on that using ICT makes teachers update in this changeable world. There are various instruments available to assist with math's instruction. Technology should help in the formation of a teaching group through social media platforms such as Viber, Messenger, and Zoom. ICT forces educators to stay current in this dynamic world. Through social media sites like*

Viber, Messenger, and Zoom, technology should aid in the establishment of a teaching group.

Participant C said; *By integrating mathematical software and school management software, ICT assisted us in resolving mathematical problems and made it simpler for students to complete homework, project work, and evaluations ;school management software, (IEMIS). This indicates that ICT aids in the teaching of learning to assessment phase. It makes it simple to assess the results of the students' learning. I believe that ICT supported us in solving mathematics problems and made it easier for learners to complete homework, project work, and evaluations by utilizing mathematical software and school management software (IEMIS).*

Participant D shared; *I agree on that ICT has helped in the teaching and usage of each app association, as well as the knowledge to use mathematical software to discover and construct mathematical educational materials, and to train students and choose teaching methods based on their interests, requirements, and subjects. There are numerous materials available to aid in the teaching of mathematics. Technology, such as Viber, Messenger, and Zoom, should assist in the formation of a teaching group. Smartphone, math pads, social media groups, and student evaluation are examples of frequent teaching and learning activities with the skills to use mathematical software to find and create instructional materials in mathematics, as well as the ability to educate students and select teaching techniques depending on their interests, needs, and subjects, ICT aids in the teaching and utilization of each app association.*

From the narrative responses of above it say that after teaching through the ICT, teachers become able to use different ICT tools and software which directly develop their professionalism. Digital infrastructures like printers, computers, laptops,

tablets, etc. are just a few examples of ICT tools for teaching and learning. Other examples include software programs like Google Meet and Google Spreadsheets. ICT tools for teaching and learning have the potential to make learning enjoyable for both teachers and students.

In this modern period the use of ICT in teaching mathematics provides new possibilities in teaching profession. Research Bansal, (2007) indicates that ICT can change the way of teaching and it is useful in supporting more student centered approaches to instruction and in developing the higher order skills and promoting collaborative activities. That is why, Mathematics teachers should be provided with different professional development trainings including use of ICT in the mathematics classroom according to the demand of time.

Classroom management. Classroom management refers to the skills, techniques, and tools that teachers use to ensure that the classroom runs smoothly. It is the skills, techniques, and tools that teachers use to ensure that the classroom runs smoothly and that students have a favorable learning environment in which to grow academically and socially.

Participant A articulated; *Of course different tools and materials help in classroom management process. In comparison to the others tools, ICT tools have the very effective role to manage the classroom effectively and make the classroom smart. A smart classroom is outfitted with a variety of technologies that are directly used for teaching and learning. Laptops or tablets, e-books, software packages, digital whiteboards, and other devices are examples of smart classrooms. Use current e-books and online information rather than previous textbooks, personalize instruction for each student, encourage them to collaborate in a number of different locations, discover user-friendly technology for students, and provide a combination of digital*

and offline instruction.

Participant B said; *Different ICT tools computers, projectors, and other multimedia devices to teach students in a smart class is the need of students these days. Use of ICT makes the class room more creative, interactive and more interesting so that all the students in the class can learn the lessons, term effectively and construct the knowledge of the subject matter and learn the global dimension in teaching and learning mathematics. I use variety of technologies like as slide presentations, audio and video conferencing, and application sharing, and shared white boards. . When I teach using videos, internet, etc., I get lots of opportunity to communicate with students. Students become more active. Computers, projectors, internet access, and other multimedia devices have the very important role for the smart class.*

Participant C expressed; *Teachers play a critical role and bear significant responsibility for improving classroom instruction. In smart classroom management, ICT is an essential tool for supporting effective teaching and learning activities. Mathematics teacher constantly thinking about acceptable approaches, techniques, and ideas to use in the classroom. Math classes are made more entertaining by using audio-visual material. I am constantly thinking about acceptable approaches, techniques, and ideas to use in the classroom. I solve difficulties and provides solutions in our course. I play a critical role and bear significant responsibility for improving classroom instruction. Math classes are made more entertaining by using audio-visual material. In smart classroom management, ICT is an essential tool for supporting effective teaching and learning activities.*

Participant D stated; *the teacher takes on more of a facilitator role in a constructivist classroom, and the students actively participate in the class. It is*

important for the learners to jointly create new information, they are encouraged to engage and exchange ideas. Teachers can select from a variety of technologies like as slide presentations, audio and video conferencing, and application sharing, and shared whiteboards. Smart Teaching Solutions is a company that works with a wide range of practical teaching tools and materials for instructors, such as teaching games and simulations. Smart Teaching Materials provide exercises and examples that teachers can use in their classes. Visual learning multimedia teachings are dynamic.

From the above narration it is claim that use of different ICT tools makes the class room more creative, interactive and more interesting so that all the students in the class can learn the term effectively and construct the knowledge of the subject matter and learn the global dimension in teaching and learning mathematics. The teacher is an important person in the classroom who helps to make teaching and learning activities more effective and enjoyable. ICT motivates the students for the interaction and also concept can be built by the visual materials, For example; while teaching the volume of pyramid in class ten, the picture drawn into the board seems as parallelogram in the base that could create the misconception on students, carrying real pyramid into the class may not be possible, so visual of pyramid or 3D Drawing of pyramid helps them to make the concept of the shape.

Expensive. Difficulties in using ICT and Mathematics software are related to the weakness of any Mathematics teacher's knowledge of what technology is available and how to use them while teaching and learning Math. Mathematics teachers will have to take considerable challenges in both Math contents and computer technology.

Participant A stated; *In our government schools applications and software*

designed for Math education are quite expensive and hard to find. There are several variables that can influence how technology is used in educational practices, including infrastructure-related variables, human resource-related variables, software and hardware-related variables, and technical variables. Despite the software's availability, there won't be enough training to use it. I can say that using ICT is difficult for students and teachers.

Participant B articulated; *Although there are many various kinds of hardware and software available, they are very expensive and challenging to operate. Like laptops, smart boards, and projectors, which are expensive for families in the lower and middle classes. Costly and challenging for beginners to use programs like Mathematica, GeoGebra, Math pad, and Braining camp. There are different types of hardware and software in the market but they are very costly and difficult to use.*

Participant C expressed; *Most software's available in market are free for 7 days or 30 days like Braining Camp which is available of only 30 days. After completion of trial period they demand for huge sum of amount for activation of software's. The required sum of money is not affordable for teacher and school or institution will not sponsor for the capital amount.*

Participant D said; *Teaching materials are expensive and strenuous to use and also tough to manage the software. Like when taking online classes on Zoom application it has time limit of 45 minutes and certain user limit. After completion of time limit it will demand for huge amount of money which I cannot afford and school will not provide the required amount of money. The program is difficult to manage, costly, and requires a lot of effort to utilize.*

From the narrative responses of above it say from the different software and tools are expensive and difficult to get in everywhere. Developing countries,

technology implementation into education systems is a difficult task as it requires a magnum of funds, infrastructure and support facilities. That is why, mathematics teachers should be provided with different professional development trainings including use of ICT in the mathematics classroom according to the demand of time. Students are not motivated in the learning of mathematics and do not visualize mathematical knowledge on them. Students prefer to learn in the screen like computer, TV, mobile and other screen based devices. So, to address these screen based generation, our teaching should be globally accepted and must be students centered.

Time consuming. Shortage of time-in schools, teachers are usually burdened with multiple tasks other than teaching. Moreover, they have to teach all types of subjects along with ICT. They do not have time to design, develop and incorporate technology into teaching and learning. The teacher needs time to collaborate with other teachers as well as learn how to use hardware and software and at the same time keep oneself updated with the latest technology.

Participant A said; *In School teaching time for a class is about 40-45 minutes which is very less to guide to use software's and teach course content. It is also difficult to design teaching material and make it use. Like making 3D design materials in GeoGebra and explaining it. Teaching and demonstrating the software take more time which is not sufficient on 45 minutes class and I cannot give time from home due to personal reasons. At the classroom teacher has for about 40 to 45 minutes for teaching, which is very short time to explain the material and teach by using different software and ICT tools.*

Participant B stated; *Due to lack of flexible time it is difficult to start the software and teach the students in class. Lack of technical knowledge causes*

distraction in class if any problem occurs during the teaching time. Lack of proper infrastructures on school interrupts class due to cut off of electricity and internet which is more time consuming. It is challenging to launch the program and instruct the pupils in class due to a shortage of flexible time. If an issue arises while the teacher is lecturing, a lack of technical understanding will distract the class. The lack of adequate infrastructure at the institution causes class interruptions due to lost internet and electricity, which takes more time.

Participant C said; *Making question sets caused more time due to lack of technical knowledge and evaluating the student's works also consumed more time. Teaching ICT methods to students brings more distraction to student which will take more time in learning. Giving access to computer and internet for student's, diverts their minds towards game and other contents rather than teaching materials. Due to a lack of technical understanding, creating question sets took more time, and assessing the students' work also took longer. Students become more distracted when learning ICT techniques, which lengthens the learning process. Giving students access to computers and the internet causes them to focus on games and other entertainment instead of learning materials.*

Participant D expressed; *There is no time to finish up the syllabus and prepare the students for examination. I need to teach arithmetic, algebra and geometry and additional exercise books. Teachers have to prepare lots of extra materials for the assessment. Moreover, we are overloaded with our tasks where we have to conduct the school-based assessment.*

From the above narration it is claim that teaching through the ICT tools need the more time. It requires extra timeframe. There is not enough time to complete the course and have the students ready for the test. Math, algebra, geometry, and

supplementary exercise books are needed for teaching and learning. For the assessment, teachers must prepare a ton of extra resources. Furthermore, we have too many chores to complete, including the school-based exam. It demands additional time. Teachers always depend on the information that searched from the web. It may make a mistake. Information from the web or internet that mostly came or wrote from personal's opinion. It is not all facts by the way. Teacher who depend more on the ICT do not perform well as a teacher. For example, they may not check through the details of the work that searched from the web. Designing and implementing instructional materials is equally challenging. Like creating and describing 3D design materials in GeoGebra. Class time does not allow enough time for teaching and software demonstration, and professors are unable to provide time from home owing to personal obligations.

Section II: Perceptions of Mathematics Teachers Towards TPD and ICT

Information and communication technologies (ICTs) have got still very impact on the teaching-learning process, their effect was also in the past at the beginning of the century. many teachers find that interesting and well-planned tasks, projects, and resources provide a key to harness-in the educational potential of digital resources, Internet com-medications and interactive multimedia to engage the interest, interaction, and knowledge construction of young learners.

Importance of ICT on TPD. The use of ICT in the mathematics classroom has primarily held of particular concern to mathematics educators. Students' motivation and confidence are increased when technology is integrated into classroom instruction. According to Iloube 2013 state ICT can provide more flexible an effective ways for professional development for teachers, improve pre and in service teachers training and connect teachers to the global teacher community.

Participant A said; *In my view ICT is important for the professional development of the Mathematics teachers. While teaching I use videos, smart board and sometimes GeoGebra software also. I create the different materials on the computer and showed at the classroom. Students become more active while I am teaching through technology. The benefits of ICT in education is of such that students in the classroom can all learn from the curriculum material. Students with special needs are no longer at a disadvantage as they have access to essential material and special ICT tools can be used by students to make use of ICT for their own educational needs.*

Participant B expressed; *I use ICT for my professional development in terms of teaching, learning and for self-learning skills. In this technological world knowledge about different technology became essential. One of the key skills for the 21st century which includes evaluating, planning, monitoring, and reflecting to name a few. The effective use of ICT in education demands skills such as explaining and justifying the use of ICT in producing solutions to problems. Students need to discuss, test, and conjecture the various strategies that they will use.*

Participant C stated; *Sometimes students ask the very difficult questions. In this case I promise them to clear about that problem tomorrow. I will search on the internet and solve the problem. Then next day I make students able to solve the problems in the easy way. ICT enhances subject learning. It is well known these days that the use of ICT in education adds a lot of value to key learning areas like literacy and numeracy. ICT use develops ICT literacy and ICT Capability. Both are 21st-century skills that are best developed whilst ICT remains transparent in the background of subject learning. The best way to develop ICT capability is to provide them with meaningful activities, embedded in purposeful subject-related contexts.*

Participants D expressed; *Of course ICT play the very important to develop my professionalism. I get lots of resources for teaching and learning on the internet and youtube. I also use different software which make my teaching process so easier. I just have to put a laptop, iPad or computer in the classroom to understand how this works. ICT naturally brings children together where they can talk and discuss what they are doing for their work and this in turn, opens up avenues for communication thus leading to language development.*

From the narrative responses of above it say that society's demand for new technology has not left out children and their needs. In modern science and technological societies education demands more knowledge of teacher regarding ICT and skills to use ICT in teaching and learning process. Children are fascinated with technology and it encourages and motivates them to learn in the classroom. When ICT is integrated into lessons, students become more engaged in their work. Teachers can use ICT to make teaching and learning activity more effective and interesting. A competent teacher has several skills and techniques for providing successful teaching. So development and increase of skills and competencies of teacher required knowledge of ICT and Science and Technology. The knowledge of ICT also required for mathematic teachers during teaching because this integrated technological knowledge helps a perspective teacher to know the world of technology in a better way by which it can be applied in future for the betterment of students.

Relationship between ICT and TPD. ICT helps teacher to update the knowledge skills to use the new digital tools and resources. It is one of the major factors for producing change in teacher's profession. Because of the growing opportunities for ICT integration in every area of the educational environment, teachers in the twenty-first century face new problems

Participant A said; *In this modern period the use of ICT in teaching mathematics provides new possibilities in teaching profession. Students who are often exposed to technology in the classroom have higher math skills, presenting abilities, and are willing to put forth more effort in their study, all of which have a positive impact on their professional growth. I feel that Information and Communication Technology in Education is a method of education that makes use of ICT to support, improve, and optimize information delivery.*

Participant B expressed; *ICT has invaded and transformed many aspects of our lives to the extent that we live in an environment that is dominated by technology. The ICT learning is a rising trend where the education has outgrown the physical constraints of the classrooms and acquired mobility. Our lives have been invaded and transformed by ICT to the point where we now live in a technologically dominated environment. With the rise of ICT, education has evolved beyond the confines of the traditional classroom and gained mobility. Students may access information whenever and whenever they want, and the number of institutions offering such cutting-edge technology environments is growing daily.*

Participant C stated; *With the growing opportunities of ICT integration in every area of teaching mathematics, teachers in the twenty-first century face new problems. TPD were the engagement of stakeholders in developing a shared vision about the role of ICT in education, and engaging teachers in school-based communities of practice or professional learning networks, as an effective means of developing ICT-integrated pedagogy. Teachers in the twenty-first century face new challenges as a result of the expanding prospects for ICT integration in all facets of mathematics instruction. In order to effectively build ICT-integrated pedagogy, TPD focused on getting stakeholders to have a common understanding of the role of ICT in*

education. It also involved getting teachers involved in school-based communities of practice or professional learning networks.

Participant D expressed; *Students who are continuously exposed to technology through education has better ‘mathematics skills’, presentation skills, and are ready to take more efforts into learning, which helped them on professional development. Students who are regularly exposed to technology in the classroom learn arithmetic more effectively and are willing to put forth greater learning efforts, both of which are beneficial to their professional growth.*

From the narrative responses of above it say that excellent teacher professional development established as a continuum ranging from pre-service throughout in-service training is vital in the age of information technology, characterized by constant change and advancements. Research Bansal , (2007) indicates that ICT can change the way of teaching and it is useful in supporting more student centered approaches to instruction and in developing the higher order skills and promoting collaborative activities. Also UNESCO (2009), state that the use of ICT promotes the quality in education. That is why, Mathematics teachers should be provided with different professional development trainings including use of ICT in the mathematics classroom according to the demand of time. Students are not motivated in the learning of Mathematics and do not visualize mathematical knowledge on them. Students prefer to learn in the screen like computer, TV, mobile and other screen based devices so, to address these screen based generation, our teaching should be globally accepted and must be students centered.

Challenge to use ICT on TPD. The result of the findings showed that ICT can take away valuable learning time, it can be overused, also. It can turn educational experiences into games for students and thus enhances low academic performances.

Teachers can observe students different skills and activities which are important for the professional development of mathematics teacher.

Participant A said; *Though I use various technology as a teaching materials, sometimes I am unable to use different updated technology. Effective teachers training, effective feedback, seminars class is needed. Technology utilization de facto, however, is far from being a means for systemic change in teacher's professional development of mathematics teachers. Here participant said that he used different tools for teaching mathematics for the secondary level students. In this technological world teachers needed to be updated on the basis of situation but the change of different technology can create the problems for the teachers. Different software which are developed to teach mathematics and different teaching material are being updated but teacher are unknown about it.*

Participants B said that *in our Nepal context using ICT on the teaching career and professional development of the mathematics teachers can create some problems. When I am teaching through videos and power point student are less active on learning process and I feel difficult to attract them on learning. Teachers need to have knowledge and skills of using technology before they can discover how to implement it. For example the use of internet, computer, GeoGebra, Mathematica etc. are essential for the teachers to learn and make student practice on them.*

Participant C expressed that *ICT is very useful tool but sometimes it become a problems for me. While using computer, internet and different technology as a teaching materials in mathematics teaching teachers should face the different difficulties like, difficult to attract the student's attention on the content, make students able to use different learning materials, etc.*

Participant D expressed that *in the starting phase not only students teachers*

also have to pass various problems. Different ICT tools computer, YouTube, smart board, etc. are more expensive and most of the schools cannot afford it. In the starting phase of using ICT tools in teaching and learning process different tools create the problems for both students and teacher. Some schools and teachers cannot afford the various expensive technological teaching materials. It also take more time to prepare and used inside the classroom. Teachers may face the problems about time and money.

From the above data it can say that in our Nepalese setting, the use of ICT in the teaching career and professional development of mathematics instructors can pose certain challenges. When teachers teach using YouTube videos, students may not pay attention to the films and there is low time to communicate. When teachers use ICT tools for teaching, and learning various things from internet it causes the less communication opportunity. Different ICT tools like internet, computer, YouTube, power point, GeoGebra, Mathematica, etc need the more time and money so It could be challenges for teacher.

Chapter V

FINDINGS, CONCLUSION AND IMPLICATIONS

This chapter conveys the summary and findings of the study, conclusion and implication of the study based on the analysis and interpretation of the data in previous Chapter IV. Then finally, the recommendations for different levels are presented.

Findings

This study has the qualitative data which was collected from the narrative inquiry. It is a research where participations narrations helped to find out the perception of teachers towards the role of ICT on TPD. This research was done in Sindhupalchok district. There were four participants who had seven years of experiences on teaching mathematics subject. I collected the data by using narrative inquiry research design. I interpreted and analyzed the data from narrative inquiry. Based on the data analysis performed on chapter IV I found the following findings.

Praxis of ICT

Development of teaching skills. Teachers can employ a variety of teaching strategies and approaches by utilizing different technology, such as a computer, calculator, various apps, etc. The main advantage of more learning tools, including software and websites, is their beneficial outcomes. The educational ICT programs offer a fresh structure that allows enhancing the methods of teaching and studying mathematics.

Help to use teaching materials. ICT can be used by students to make calculations, create graphs, and assist in problem-solving. Problems can be solved via spreadsheets, computer algebra systems, or graphical calculators. The new digital ICT is a conglomeration of hardware, software, multimedia, and delivery methods rather

than a single technology.

Help to use Technology. Teachers need to be aware of how to use technology in the classroom effectively. ICT is transforming how mathematics is taught and learned by bringing life to classroom learning environments, including specially designed virtual environments. It can help teachers stay focused on the National Curriculum and avoid getting sidetracked by extraneous concerns.

Classroom Management. The many technologies in a smart classroom are specifically employed for teaching and learning. Smart classrooms include things like laptops and/or tablets, I gadgets, e-books, software programs, digital whiteboards, and other gadgets. The abilities, methods, and resources that instructors employ to make sure the classroom operates well are referred to as classroom management.

Expensive. The availability of the most modern hardware and software facilities impacts how effectively and efficiently technology is used. The integration of technology into educational systems in poor nations is a challenging endeavor since it necessitates massive amounts of resources, infrastructure, and support services.

Time Consuming. Teachers in schools are frequently tasked with duties outside of teaching. They also have to teach a variety of other disciplines in addition to ICT. They lack the time necessary to plan, create, and integrate technology into teaching and learning. The teacher requires time to work with other educators, understand how to utilize hardware and software, and stay up with the most recent technological developments.

Role of TCT on Teachers' Professional Development

Importance of ICT on TPD. For the most part, math educators have been particularly concerned about the use of ICT in the classroom. Portable graphic calculators, computerized graphing, specialized software, spreadsheets, databases, and

other tools are a few examples of how ICT is used in math. Technology integration improves student motivation and self-assurance in the classroom.

Relationship between ICT and TPD. The rising opportunities for ICT integration in all elements of mathematics instruction presents new challenges for teachers in the twenty-first century. TPD concentrated on encouraging stakeholders to have a shared view of the importance of ICT in education in order to effectively develop ICT-integrated pedagogy. Additionally, it required involving teachers in professional learning networks or communities of practice headquartered at their own schools.

Challenge to use ICT on TPD. Different technologies cause issues for both students and teachers in the early stages of integrating ICT tools into the teaching and learning process. The many pricey electronic teaching supplies are beyond the means of certain schools and teachers. Additionally, using it in the classroom and preparing for it takes additional time. Teachers could experience issues with time and money.

Conclusion

Teachers can gain knowledge in their specialized profession in a variety of methods. The Internet is now considered to be the best technology for finding the information we need. The government has initiated distributing computers and Internet access in government-run schools in Nepal as well. To determine whether Secondary Level Mathematics teachers in the Indrawati Municipality of the Sindhupalchok district use the Internet to broaden their knowledge, keep up with current educational innovations and developments, and to build their professional abilities and mathematical expertise.

The vast majority of those respondents participated in online conferences. They claimed that a vast amount of beneficial information about teaching is available

on the internet. The majority of mathematicians are aware that technology integration in the classroom is beneficial and that teachers should be familiar with technology and the Internet. Respondents shared their opinions, arguing that adopting a good attitude toward technology and the Internet is essential for teachers to advance their careers. They also mentioned the value of online resources in creating instructional materials that are both necessary and acceptable.

For their professional development, the majority of respondents have used a variety of software programs, including GeoGebra, Mathematica, and Braining Camp. In fact, teachers are using the internet to hone their abilities. Additionally, they are harnessing the internet to create educational resources that are relevant and necessary. Their lives were easier and more productive thanks to the computer. Although the software's are very useful on teaching in daily classes, they are very expensive to buy, as well as it consumes more time on learning to use it. Finally, it was found that mathematics teachers of Sindhupalchok district found improvement in their professional development after using different tools and software's through Internet.

Implications

Policy related. Several studies have explored the significant use of computers and Internet in teachers' pedagogical activities. These studies indicated that teachers can play a significant role to integrate ICT for their effectiveness regarding their instructional activities. A solid ICT based infrastructure is needed and should be planned by the policy makers while teachers should be responsible to implement these policies in their institutions. The proper financing, adequate training and comprehensive planning are required for integrating. CT tools should be included in mathematics education as well. The government should offer instructors workshops, trainings, and lectures on ICT.

Computers in schools should be managed by the government for both teachers and students. Teachers should have free and/or easy access to the Internet's resources.

Practice related. Teachers need to be updated with the recent trends and innovations regarding ICT tools and software's through internet.

Further research related. As its objective suggest this research was only limited to the perceptions of mathematics teachers towards role of ICT on TPD and praxis of ICT on professional development of mathematics teachers. Furthermore it is limited by the research design. The research was conducted only in Sindhupalchok district so finding may not be generalized to other areas and situations.

I recommended that future study should be conducted quantitatively or mixed method with small or large sample size. Similarly, participants in this study were from the village and public schools. Suggesting that it could be conducted in cities and private schools. Many studies can be conducted on importance of ICT in TPD, use of Internet on TPD, necessity of ICT on TPD, etc.

References

- Acharya, B. (2011). *A critical inquiry of cultural relevance of primary level school mathematics education of Nepal*. Kathmandu : An unpublished mini research division .
- Benning. (2019). *Professional Development For Using Technology in Mathematics Teaching in Ghana*. New Zealand: University of Otago.
- Bistha. (2011). *Transfer of training skills in the classroom delivery at primary levels mathematics teaching*. A master's thesis submitted to central department of mathematics education T.U.,kirtipur.
- Blanchard, M., Leprevost, C., Deel.Tolin, & Gutierrez, K. (2016). *Investigating technology-enhanced teacher professional development in rural,high poverty middel school*. Oxford: Oxford Univesity Press.
- CERID. (2003). *Trasfer of training skills in the classroom delivery: A Research Report*. Kathmandu: CERID.
- Chao.GM. (2015). Impact of teacher training on ict intergration in public secondary school in mombasa countyr. In *Human resource management research* (pp. 77-94).
- Chetty, P. (2016). *Importance of research approach in a research*. Oxford: Oxford Univesity Press.
- Creswell, J. W. (2011). *Educational research: Olanning,conducting and evaluating quantative and qualitative research*. New Jersey: Pearson Education International .
- Dhital, H. (2018). Opportunities and Challenges to Use ICT in Government School Education of Nepal. *International Journal of Innovative Research in Computer and Communication Engineering*.

- Durkheim, Emile (2004). *Durkheim's Philosophy Lectures: Notes From the Lycée de Sens Course, 1883–1884*. Cambridge: Cambridge University Press.
- Driver, R., (1994). Constructing Scientific Knowledge in the Classroom. *Educational Researcher*, 23, 5-12.
- Guoyuan, S. (2010). Computer and Education. *Student teachers thinking processes and ict integration*.
- Helen And Daminabo, D. (2013). Barriers to the effective intration of Ict to university education in Nigeria. 1-8.
- Kenya, M. o. (2006). *National communication and technology (ICT) strategy for education and traning*.
- Kiru E.W. (2017). Mathematics teacher's use of ICT . In *An international Comparision, vol.4* (pp. 165-177).
- Leedy, P. D. (1997). *Practical research: Planning and design*(6th Edition).New Jersey:Prentice-Hall.
- Nansone, I., & Dudareva, D. (2014). *Teacher's continous professional development*.
- Niekeker, M., & Blignaur, S. (2014). A framework for ICT intergration in school through teacher professional development. *Africa Education Review* , 236-253.
- Pandey, S. (2011). *Professional development of teacher through relective practice*. Kathmandu: Unpublished PHD,Dissertation.
- Ratemo, J. (2011). Embrace E-learning. In *Research into Learning Mathematics* (pp. 15-20). kenyan: digital learning in kenya school.
- Sharma, B., & Shrestha, R. (2013). *English language teacher development*. Kathmandu: Sunlight Publication.

Tinio. (2002). *ict in education. e-primers for the information Economy,society and polity .*

Vygotsky, L. S. (1978). *Mind in Society : The development of higher psychological processes.* Cambridge,MA: Harvard University Press.

Appendix

Guideline for Interview with Mathematics Teacher

Name of Teacher:

Subject:

Class:

Warning Period:

The interview with teacher was taken on the basis of following main topics

1. What is TPD? Why do teachers need it?

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2. Why is TPD given to math teachers? Why is this important?

.....

3. Is TPD helpful for teachers in any way?

.....

4. What is ICT? How do you use ICT in mathematics teaching?

.....

5. What are the advantages and disadvantages of using ICT in teaching mathematics?

.....

6. Based on your experience, what is the benefit of using ICT while studying mathematics?

.....

7. What are the benefits of ICT for math teachers?

.....

8. What differences have you found in classrooms or teaching activities between teaching using ICT and teaching without using ICT?

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9. Based on your experience, what are the disadvantages of using ICT while studying mathematics?

.....

10. What are the challenges of using ICT in mathematics TPD?

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