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DIGITAL LITERACY AND ONLINE LEARNING IN MATHEMATICS EDUCATION

**DIGITAL LITERACY AND ONLINE LEARNING IN MATHEMATICS  
EDUCATION**

**A  
THESIS  
BY**

**DHANKALA KUMARI BIST**

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THE DEGREE OF MASTERS OF EDUCATION**

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### Letter of Certificate

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Date: 7 March, 2022



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### Letter of Approval

This thesis submitted by **Dhankala Kumari Bist** entitled on "**DIGITAL LITERACY AND ONLINE LEARNING IN MATHEMATICS EDUCATION**" has been approved as for the partial fulfillment for the requirement of Master's Degree in Mathematics Education.

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**RECOMMENDATION FOR ACCEPTANCE**

This is to certify that **Ms. Dhankala Kumari Bist** has completed her M. Ed. thesis entitled **“DIGITAL LITERACY AND ONLINE LEARNING IN MATHEMATICS EDUCATION”** under my supervision during the period prescribed the rules and regulations of Tribhuvan University, Kirtipur, Kathmandu, Nepal. I recommend and forward her thesis to the Department of Mathematics Education to organize the final viva-voce.

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### **Dedication**

This work is heartily dedicated to my respected parents Madhav Prashad Bohara and my all family members and all persons whose support, love, care and sacrifices made me a person who I am now.

## DECLARATION

This thesis does not contain any others work which is offensive and beyond the copy write norms. To the best of my knowledge and beliefs this research is truly based on my effort and it does not match with any researches that were published earlier in this university as well as others. I take all the ethical and legal responsibility for submitting this thesis.

.....

Dhankala Kumari Bist

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## Abstract

This is a qualitative and Descriptive research on the topic entitled "**DIGITAL LITERACY AND ONLINE LEARNING IN MATHEMATICS EDUCATION**".

This research work is an attempt to find the existing situation of digital divide in Bajhang district. This research also attempts to explore the challenges and opportunities of online learning in mathematics education. The research was based on the qualitative and descriptive on the digital divide in the school of Bajhang district. Schools of five municipalities of Bajhang district was selected as the research site. Purposive sampling method was used to select representative respondent. In-depth interview and observation form were the tools adopted for collection of information. The collected data were analyzed on the basis of basis of my conceptual framework.

The major finding revolved are; there is seen big digital divides between schools same rural municipality or different municipality. There is seen digital divide between teachers in same school or different school/ in same rural municipality or different municipality. There is seen digital divide between students in same school or different school/ in same rural municipality or different municipality. There is seen digital divide in the given support to the schools of Bajhang district. From analysis, there is seen digital divide in digital literacy. Most teachers and students have low digital skills. So, online learning is not possible in the schools of Bajhang district. Some teachers of Bajhang district can run online classes but students don't have online classes facility. So, online class is not running in Bajhang District. For online class both students and teachers get online digital environment but in Bajhang, it is not possible.

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## CHAPTER - I

### INTRODUCTION

This research entitled "Digital Divide and Online Learning in Mathematics Education" is a qualitative and descriptive research. This chapter presents the background of the study, statement of the problem, objective of the study, justification of the study, delimitation of the study and operational definition of the key terms.

#### **Background of the Study**

Educational systems have been greatly affected by global technological changes and resulting reform initiatives, technology becomes more common in learning environment. Stanford defines the digital divide as "the growing gap between the underprivileged members of society...who do not have access to computers of the Internet, and the wealthy middle-class...who have access." In the same article, it mentions the factors that contribute to the digital divide, and they are: 1) education, 2) income, 3) and race. In education, it was found out that households with higher education are likely to use computers and the Internet. In income, the article mentioned that those with more than US\$75,000 are more likely to have Internet access. Finally, in a race, the data suggest that schools with a lower percentage of minorities have a higher number of computers. According to Carmen Steele, there three types of Digital Divide; 1) Gender Divide, 2) Social Divide, 3) and Universal Access Divide. Gender Divide, there is an Internet gender gap wherein, in terms of mobile connectivity, women fall behind. Social Divide, social stratification is evident among those who are connected to the Internet and those who are not. Universal Access Divide, those with physical disabilities, are at a disadvantage in accessing the Internet. In another article written by Carmen Steele, the impacts of the Digital Divide in Education are; 1) Lack of exploitation of full potential, wherein individuals from low-income families have limited access to information, resulting to discouragement and poor performance, 2) Unfair competitive edge, students who have access to the Internet have full access to assignments and materials online, and those who do not have are not able to monitor their performance, 3) Enhanced convenience in learning, the rich are empowered because they have the means for machinery while the poor are faced with many hurdles, 4) Difference in the learning experience, the rich have easy access to learning materials, while the poor have to undergo long hours of studies, 5)

and finally, Decreased productivity among the poor, developed countries produced more technical graduates, while in the developing countries are half-baked due to lack of available technology (Quito,2020) .

ICT (Information and Communication Technologies) offer many advantages: greater access to information, cost reduction in the labor sector, greater connectivity between people, etc. However, digitalization is not happening equally all over the world, because imbalance exists and this is known as the digital divide. In just a few days, the SARS-CoV-2 corona virus locked us up in the house meaning we had to study, work and look into each other's eyes through a camera. Access to the Internet has enabled many of us to get on with our lives despite the pandemic thanks to modalities such as remote working and online education but the reality isn't the same all over the world. In fact, the International Telecommunication Union (ITU), the specialized agency of the United Nations (UN), warned at the end of 2019 that almost half of the earth's inhabitants — some 3.6 billion people — do not even have access to the Internet. Inequality in access to the Internet and ICT is known as the digital divide and affects 52 % of women and 42 % of men worldwide. This gap becomes even wider when we talk about regions: according to data taken from the Internet portal World Stats as of May 2020, in Africa only 39.3 % of its inhabitants had Internet access, compared to 87.2 % of Europeans and 94.6 % of Americans. The data shows the technological gap that separates some countries from others, despite the fact that 3G and 4G networks, while awaiting the massive expansion of 5G, are already reaching almost every corner of the planet. Here, it is important to distinguish between access to the Internet and digital literacy, that is, the learning process that enables a person to acquire the skills to understand and benefit from the educational, economic and social potential of the new technologies.

The digital divide was initially attributed to underdevelopment and was perceived as something temporary that would disappear with the popularisation of technology. Instead, the divide persists today despite the mass marketing of electronic devices with Internet access. The causes can range from the high price of the above-mentioned devices to the lack of knowledge about their use or the lack of infrastructure for their access. In this regard, we review the types of digital divide:

- Access divide. It refers to the possibilities that people have to access this resource. This is where socio-economic differences between people and between countries come into play, since digitization requires very costly investments and infrastructure for less developed regions and for rural areas.
- Use divide. It refers to the lack of digital skills, which impedes the handling of technology. In this regard, and to give an example, the ITU points out that there are 40 countries in which more than half of their inhabitants do not know how to attach a file to an email.
- Quality of use gap. Sometimes they have the digital skills to find their way around the Internet, but not the knowledge to make good use of and get the most out of it. For example, with regard to access to quality information.

A few years ago, ITU established the Digital Access Index (DAI), which measures the overall ability of a country's citizens to access and use ICT. This index takes into account various variables grouped around five categories, which are as follows: quality, infrastructure, knowledge, accessibility and use

Currently, the e-learning method, due to the period of COVID-19 has been increasing its uses and application in teaching and learning methods. Growing use of digital technology in educational contexts has been noted in recent years. Digital Technology is universal in our society. The use of digital technology in the mathematics classroom has long been a topic for consideration by mathematics lecturers. Digital technology tools in mathematics include: portable, graphic calculator and computerized graphics, specialized software, programmable toys or floor robots, spreadsheets and databases. Access to digital technology via personal devices will increase, with the consequence that technology integration into mathematics education, within and outside the classroom, can be easily realized. Students will also have personal technology such as a tablet, a smart watch, a mobile phone or similar with which they are familiar to use mathematical focused applications. These tools are allowing pupils to collect data, and manipulate it using spreadsheets and databases for work in numeracy (Moseley, 2009). The use of digital tools in mathematics speeds up the graphing process, freeing people to analyze and reflect on the relationships between data (Hennessy, 2010). Mathematical specialists

software such as Computer Algebra System (CAS), Dynamic Geometry System (DGS), Matrix Laboratory (Mat Lab), Statistical Package for the Social Sciences (SPSS) and so on.

With the development of such technology tools, the question arises as to what the impact on education and teaching practices should be in order to prepare the next generation of students for future careers (Clark-Wilson, 2015). There are many implications of using digital technology tools in the teaching and learning of mathematics at college or university. As students often point out it is very exciting, enjoyable and productive to use digital tools in class. They are curious to use digital technology tools, so the environment becomes more conducive for learning. The mathematics student's natural curiosity can be utilized to its fullest potential because they are keen to explore and discover new things related to their subject matter. Digital technology tools can be a major factor in developing an exploratory approach to learning mathematics and in particular, investigating problems from multiple representational perspectives (Kumaresan, 2008). With the traditional mathematics tools, students do not often regard themselves as active participants in mathematical exploration. Digital technology tools offer a number of didactic advantages that can be exploited to promote a more active approach to learning. Students can become involved in the discovery and understanding process, no longer viewing mathematics as simply receiving and remembering algorithms and formulae (Li, 2010).

The power of digital technology tools goes beyond routine computation. It has the potential to facilitate an active approach to learning, allowing students to become involved in discovery and constructing their own knowledge, thus developing conceptual understanding and a deeper approach to learning (Ruthven, 2009). The integration of digital technology tools supports teachers, educators and researchers with many new perspectives field. The use of digital technology tools, it improves student learning, invites deeper thinking, motivated learning, more efficient or more effective learning. The use of digital technologies tools in mathematics instruction can change the teaching-learning process of related courses (Heddens and Speer, 1997).

Digital Nepal initiatives in education aim to prepare human capital to capture new economic opportunities through the creation of an enhanced teaching and

learning environment. This entails the use of digital technologies tools to support teaching, enrich the learning experience, and improve educational outcomes. It is flexibility in terms of location, time, efforts, and costs. It makes the appropriate option for training and evaluating students. Digital teaching tools are always useful and more effective for teachers and students. The need for Digital technology tools in Education has been realized. As a result, some policies have been identified and some activities related to ICT have been carried out. ICT and computer education courses have been offered in general as well as ICT in Education Master Plan 2013 technical education. During the fiscal year 2066/67 and 2067/68, the government of Nepal has supported for ICT related infrastructure and internet connectivity to 785 schools. Similarly, to improve educational management and delivery system, the Ministry of Education has provided some additional ICT related equipments to all District Education Offices and lunched website by each District Education Office. However, such ICT equipments were mostly used for administrative purposes. In June 2012, the Ministry of Education has endorsed a guideline for the implementation of ICT in school education in Nepal.

Digital technology tools have a positive impact on mathematics students learning. Digital technology tools causes students to be more engaged, thus student get more information. Because of the arrival of new technologies tools in mathematics rapidly occurring globally, technology is relevant to the students. Digital Technology tools provide meaningful experiences to mathematics student including mathematics, reading and research. It gives students opportunities to collaborate with their peers resulting in learning from each other. In this sense , The National Council of teachers of Mathematics , for example , in its position and statement claims that “Technology is an essential tool for learning mathematics in the 21<sup>st</sup> century, and all schools must ensure that all their students have access to technology”([NCTM],2008).

Although computer access is seemingly widely available in elementary schools in East Tennessee, some schools may have many computers while others have few. In addition, elementary students often have no access to computers and the Internet at home. If one assumes that academic achievement is facilitated by access to computers at schools and at home, the gap in access to technology is cause for concern (Judge, Puckett, & Bell, 2006). Schools help bridge the digital divide as many disadvantaged students only have access to computers and the Internet while at

school (DeBell & Chapman, 2003). When teachers assign homework or projects that require Internet use at home, many students are unable to access the tools necessary to succeed both inside and outside of the classroom. This creates an uneven playing field among students (McLaughlin, 2016). Digital equity is a social justice goal that should ensure that all students have access to information and communication technologies for learning (Judge et al, 2006). Equitable access is at the root of the digital divide.

### **Statement of the Problem**

Providing access to quality education and expanding learning opportunities for the mathematics student, the statement of the problem was description of an issue recent existing which needs to be addressed. This provides a roadmap for generating the questions which are necessary for research.

During 21<sup>th</sup> century, mathematics classroom is a challenging problem in the absence of online learning in mathematics education by using ICT and Digital Technology. If we want to make strong base of mathematics education, we will make sure address the digital divide in every area and use online learning in mathematics education with the help of digital technology. Manage the digital divide and online learning in mathematics education is addressed in pandemic situation such as COVID -19. In time of COVID -19, most of the students were unable to take education due to lack of digital technology, due to digital divide and due to lack of online educational facility. The study was connected with the problem of mathematics classroom without digital technology, digital divide and online learning in mathematics. Effective type of teaching-learning activities takes place only when mathematics learning is fulfilled with digital technology, decrease of digital divide and online learning in mathematics facility.

When the whole world was suffered by COVID -19, most of the services were closed such as transportation, schools, tourism, financial activities, hospitals, markets, international flights, etc. almost activities were closed. In that type of Pandemic situation, about 90% students of the world was far from the education due to digital divide, due to lack of digital literacy and due to lack of digital technology. Students of well developed countries were unable to take classes because of lack of digital technology and digital divide. When well developed countries can't address digital divide then, developing countries and non developed countries address the digital

divide not possible. So, whole world must address the digital divide gap and give same digital facility to all parts of the countries and world. If the digital divide gap and internet access are fulfilled, the whole students of the world will be able to take online education in every pandemic situation such as COVID -19.

I am the math teacher of secondary level. I was unable to give mathematics classes to the students in Corona Pandemic time. Students of my school had no internet access, some of them had no smart phone in their family, most of them had no computers and laptops, some of them had no TV and some of them had no radio. In Bajhang district, there are not sufficient internet facilities in all part because it is hilly district and is a remote area. So, at that time, I couldn't take physical class due to Corona Viruses. I was unable to take online class due to digital divide and internet access. Like as my problem whole Nepal has same. Nepal is developing countries. So, most parts of Nepal have digital divide and have less or more internet access. It means about 95% students unable to take online classes but in Bajhang district, 100% students hadn't taken online classes. In that type of Pandemic situation, students can't take online classes in every time in the future. This matter leads me on my research problem that was related to entitle “digital divide and online learning in mathematics education”.

### **Objectives of the Study**

Every research needs the objectives. Without the destination, nothing can be achieved. Therefore, the researcher was keen interested to meet the following objectives:

1. To find the existing situation of digital divide in Bajhang district.
2. To explore the challenges and opportunities of online learning in mathematics education.

### **Research Question**

To overcome my research, I formulated the following research question on my study, they were given below:

1. What was the situation of ICT instruments & internet access in the school?
2. How the situation of digital divide could be bridged in the new situation?

### **Justification of the Study**

Every research is important for their related field because they give the right information about issues. Each study is important for the institutions, scholars, professors, students and the researchers who are interested in this area. This study will reveal the digital divide and online learning in mathematics education. So, this research study will be digital divide and online learning in mathematics education: A Qualitative Descriptive Study is significant to those mathematics teachers who are teaching mathematics at Government Schools also for the schools to reform their practice of ICT integrated teaching online learning, to those policy makers in education field in at local government and central government. This study will also be useful to the researchers who want to conduct research works in the similar fields. Textbook writers, curriculum designers, methodologists can develop related idea while designing courses, textbook materials and their study. At last this study will be significant to the student teachers to develop the good way of teaching. This study includes how ICT integrated teaching or online learning with digital technology is more effective than the traditional chalk talk method.

In short the significance of this study would be as follows:

- To know about digital divide and online learning in mathematics education in school.
- To analyze the situation of digital divide and online learning in mathematics education.
- To analyze the opportunities and challenges of using online learning in Mathematics Nepali Government School.
- This study would be beneficial for mathematics teachers and schools to improve and reform their activities and strategies.
- This study would be helpful for policy makers, curriculum developers to make ICT integrated mathematics curriculum with online learning and make the innovative policies and practices.
- This study would be helpful for researchers who are interested in this area of research.

### **Delimitation of the Study**

Delimitations are those characteristics that limit the scope and the boundaries of the study. The delimitations are the researchers control (Simon, 2011). Delimitation is the process by which a researcher determines the scope of his / her study by determining in which area, how many, what kind of tools he / she wants to study based on the available resources and time (Khanal, 2076). Due to the certain time and the other related factors the researcher cannot go to the entire field. This is qualitative descriptive research about "Digital Divide and Online Learning in Mathematics education". The delimitations of this research study were as below:

- This Study would be limited in Bajhang District.
- This study was conducted qualitatively with descriptively. So, the findings of the study might not be generalized but gave the understanding of phenomenon.
- The Rural Municipality of Bajhang District and the respondents for the study would be selected on the basis of researcher's purpose and convenient by using non-probability sampling. So, the finding of the research might be less generalizable.
- The study was limited up to secondary level schools of five rural municipalities of Bajhang district.
- The required data for this study would be collected by the tools In-depth interview and observation form.
- This study was concerned with the "Digital Divide and Online Learning in Mathematics education

### **Operational Definition of the Key Terms**

**Government School / Public School.** Those schools that have obtained approval or permission and receiving the regular grant from Government of Nepal (Government School / Public School, n.d.)

**Digital Divide.** The economic, educational, and social inequalities between those who have computers and online access and those who do not (Digital divide, n.d.)

**Online Learning.** Online learning is education that takes place over the Internet. It is often referred to as “e-learning” among other terms. However, online learning is just one type of “distance learning” - the umbrella term for any learning that takes place across distance and not in a traditional classroom. Distance learning has a long history and there are several types available today, including(Online Learning, n.d.)

**COVID – 19.** Coronavirus disease 2019 (COVID-19) is defined as illness caused by a novel coronavirus now called severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2; formerly called 2019-nCoV), which was first identified amid an outbreak of respiratory illness cases in Wuhan City, Hubei Province, China. It was initially reported to the WHO on December 31, 2019. On January 30, 2020, the WHO declared the COVID-19 outbreak a global health emergency. On March 11, 2020, the WHO declared COVID-19 a global pandemic, its first such designation since declaring H1N1 influenza a pandemic in 2009 (Cennimo and Bronze, 2021)

**Digital Technology.**Digital technologies are electronic tools, systems, devices and resources that generate store or process data(Digital Technology, n.d.)

**ICT.**Information and Communication Technology refers to a range of electronic tools for storing displaying and exchanging information. But it is more specific term that stresses the integration of telecommunication, computers as well as necessary enterprise to access, store, transmit and manipulate information (ICT, n.d.).

**Internet Access.**The process of connecting to the Internet (Internet Access, 2019)

**Focus Group Interview.** A data collection method in which data is collected through a semi-structured group interview process (Cohen & Crabtree, 2006)

## **CHAPTER-II**

### **REVIEW OF RELATED LITERATURE**

Review of related literature is an essential part of the research for the researcher because related literature helps and guides researcher to meet the motto of the study. A brief summary of previous research and the writing of recognized experts provide evidence that the researcher is familiar with what is already known, and with what is still unknown and untested. Since effective research must be based upon past knowledge, this step helps to eliminate the duplication of what has been done, and provides useful hypothesis and helpful suggestions for significant investigation. The review of related literature should conclude with the summary of area of agreement and disagreement in findings. Review articles, that summarize related study, are often useful ensuring time and effort. By understanding a literature review we are able to critically summarize the current knowledge in the area under investigation, identifying and strengths and weaknesses in previous work. By reading many different studies, we will begin to gain an impression about the important aspects of the topic, identify data sources that other researcher has used, identify and become familiar with style of writing that is used particularly within the ethos of the area that we are researching, identify ideas for further consideration and create our own reading and critiquing strategy.

So, I had collected some books, journal, seminar paper, thesis, articles, researches which are related to "Digital Divide and Online Learning in Mathematics education". By deep study of these resources, I was going to review the related literature as three parts i.e. Empirical review, Theoretical review and Conceptual framework.

#### **Empirical Review**

Pahadi (2019) has conducted an unpublished thesis on "Perception of students toward digital technology and social media in learning mathematics". In this study the sample was 100 student of central department of mathematics. The study was related to quantitative research. The main objective of this study was to find out the perception of student toward digital technology. He concluded that there is no

significant difference between the perception of boys and girls students. This study shows that there is positive perception on digital technology in mathematics.

Dahal (2018) carried out a research entitle “Attitude of teachers and students toward the use of social media in teaching and learning” The purpose of this study was to find the attitude of teacher and student towards the use of social media in teaching learning and also to compare the significance of attitude of teacher and students. He took the 200 students and 100 teachers out of 2000 student and 150 teachers of community school of secondary level in Sindhupalchok district. The data collection tools were questionnaire. Chi-square distribution was uses to find out the attitude and t-test was used to find the significant difference between mean score of student and teachers towards the use of social media in teaching and learning process at 0.05 level of significance. He concluded that the teachers and students have positive attitude toward social media in teaching-learning. And also he found that the attitude of teachers toward the social media is slightly better than student attitude. There is no significance difference between teacher and student’s attitude.

John Engelbrecht, Salvador Linares, Marcelo C. Borba.(2020) conducted a survey “ Transformation of mathematics classroom with internet” The central theme for this special issue is the evolution and transformation of the classroom with the growing integration of the internet and interactive digital device into math-mathematics teacher education. New trends in mathematics education, and they emphasize in this paper, changes in the mathematics classroom itself and the speed of digital technology may accelerate this deterioration of the paper.

Rana (2019) conducted an international research “Implementation of Nepal’s education policy in ICT:Examine current practice through an ecological model”. This study found that Educational policy implementation can be conceptualized in terms of an ecological model that explores roles and relationships within a complex evolving environment. This article draws on an ecological model to examine Nepal's implementation of its policy for information and communication technology in education. The policy is developed by government and mandated to schools, but government does not commit funding to resource infrastructures or train teachers in information and communication technology (ICT) use. This also talked about the current level of success in implementing the ICT in education policy in rural schools

in Nepal has been achieved by the work of two unconnected systems, the Department of Education and its operational bodies, and the NGO and its agents, to variously provide for rural schools. None of the actors in the system, agency or individual, is responsible for the whole programmers. The interrelationship that evolved among them has sustained the survival of the policy within which the actors are currently involved. To an extent, the two largely symbiotic systems have resulted in the successful implementation of ICT in education in the resource poor rural context of Nepal.

We have argued not only that the model is useful in explaining what is already occurring but also that model helps to identify dangers that may occur. Ecology is the description of a living and changing collection of organisms and their relationship to each other and their environment

Israel (2015) carried out a research paper “Effects of mathematics innovation and technology on student in open distance learning” This study investigated the effect of mathematics innovation and technology on students’ academic performance in open and distance learning. Quasi – experimental research design was used for the study. The sample of population for the study consisted of all the 200 level primary education students at the National Open University of Nigeria and Lagos State .The sample of this study was made of 60 students randomly selected using stratified sampling technique. It can assist in planning online teaching and learning effectiveness. It can assist pre-professional mathematics teachers to explore the advantages of internet intranet learning to participate in mathematics, as well as designing various strategies that promote effectiveness. It hoped that the readers and stakeholders in education and those who believe in mathematics innovation and technology, gender, school environmental can promote teaching effectiveness and promote mathematics culture in dealing with students.

Kamau (2014) Conducted a Dissertation entitled "Technology Adoption in Secondary Mathematics Teaching in Kenya: An Explanatory Mixed Methods Study". The purpose of this study was to examine the factors related to technology adoption in mathematics teaching in Kenya. This study employed a mixed methods research design that used a sequential explanatory approach and taken survey questionnaire for quantitative phase and observation as well as audio interview for qualitative phase as

the tools for data collection. The data was analyzed by the sequential multiple regression analysis at quantitative phase and thematic method at qualitative phase.

The researcher concluded that through training Kenyan teachers can alter how they think about technology and how they use it in their classroom. I believe that the skills gained through technology training can support teachers to teach mathematics in environments where students can explore difficult problems and investigate multiple representations as opposed to using such tools for illustration, practice, drill activities, and teacher-centered activities such as document production, and presentation. If mathematics teachers are afforded opportunities to make meaningful use of technology, students might change how they view mathematics, particularly as technology may assist them to think critically, investigate situations, make generalizations, and see patterns. He suggested that the kind of technology knowledge needed by Kenyan teachers at the moment is the knowledge that will change how students feel about learning mathematics.

Bature (2016), Carried out a study entitled, "The Role of Information and Communication Technology (ICT) as a Tool for Effective Teaching and Learning of Mathematics". The objectives of this study were to find out whether the use of ICT tools in teaching and learning of mathematics improves students' performance and achievements, to find out whether the use of ICT tools enhances teaching and learning of mathematics and improves students' problem-solving skill and to find out whether the use of ICT tools motivates and makes students interested in learning mathematics. To attain these objectives, the researcher adopted survey research design and was conducted in Kafur Local Government Area of Katsina State. The target population was the entire students and mathematics teachers in Kafur Local Government. Five out of ten secondary schools in the area of study were randomly selected as a sample. The instrument used was questionnaires for both teachers and students. The data was analyzed by simple percentage and chi-square test. After analyzing and interpretation of the data the researcher concluded that effective use of ICT tools in teaching and learning of mathematics improves students' performance and achievements, use of ICT tools enhances teaching and learning of mathematics and improves students' problem solving skills and use of ICT tools motivates and makes students interested in learning mathematics.

Dhakal (2018) conducted the study entitled " Use of ICT tools in Mathematics in Higher Education: A case of Mid-western University". The purpose of the study was to examine the ICT tools in mathematics teaching and understanding the attitude of teacher towards ICT tools and the barriers of integrated ICT in teaching mathematics. To attain the objective the researcher used the survey research design by using the questionnaire, class observation and interview as data collection tool. The sample was taken 8 teachers of Mid-western University by the purposive sampling method.

The result of the study indicated the positive attitudes of teachers along with the need of the use of the ICT tools for professional development of teachers and increase the performance of the learners as the learners were found motivated by the recent development of the tools. However, the lack of knowledge to integrate the tools, availability of the resources, affordability by the learners and insufficient teacher training provisions were found as the barriers in the use of ICT tools.

Joshi (2016), carried out a research entitled, "Status of Use of ICT by Secondary School Students of Nepal". The main objectives of the study were to study the status of ICT instruments with secondary school students and use of ICT by secondary school students at their home and school. To attain the objective of this study, the researcher used the quantitative research design by using the questionnaire as data collection tool.. Data was collected by 106 students of class 9 and 10 from three schools of Kathmandu districts of Nepal, schools were selected by purposively and all available students during data collection period were taken. "Students' questionnaire for the use of ICT" has been used for the study developed by researcher. Nature of instruments was multiple options and Likert five point scale types of questionnaire. Export validity was calculated and reliability was calculated by Cronbach's Alpha and it was found to be 0.90. Data were collected by providing questionnaires for the students in the classroom by taking permission and help of principal and class teacher. Data has analyzed by using percentage, mean, SD and Mann Whitney U test.

From above analysis it can be conclude that utmost numbers of students are poor in technological feature. Public and public school students do not differ in the use ICT at home and same result was found in case of boys and girls students. In case of use of ICT at school significant result was found in case of private and public

school students even that result is not differ in case of boys and girls students. By this result we also can says that school, guardians, governmental and non-governmental bodies, policy maker, financers and other related stakeholders should make excellent plan for the improvement of learners ICT skills for their future development.

Hutchings (2019), carried out A Dissertation for doctor of education entitled, " an Analysis of the Digital Divide among Elementary Students and its Effect on their Education". The main objectives of the study were to identify the digital divide that exists among elementary students and to identify teacher and student perceptions of how Internet access at home affects an elementary student's education. To attain the objective of this study, the researcher used mapping and interpreting in the final stage of data analysis. Only students in grades 3-5 were included in Rural area which are outside of the city. The findings in this study showed that while many students may have Internet access at home, it is often by way of a Smartphone. Students reported that many of the things for which they need the Internet are not accessible using a Smartphone. Therefore, even if students have Internet access at home, inequality still exists regarding access to the Internet both at school and in the home.

In another study (Burke, 2020) the authors posited that online learning and teaching require skills that need to be developed; we are on a steep learning curve and, from this report, we are doing well. We are being forced to think in different ways, to solve problems together, to collaborate and to communicate in different ways, to educate and be educated in a different way. Due to COVID-19 global crisis, there is an increasing number of recent studies focusing on educational technology and technology in education (e.g., Agnoletto & Queiroz, 2020; Demuyakor; Mulenga & Marbán, 2020; Poh-Sun Goh & Sandars, 2020; Smith, 2020; Zhao & Xu, 2020); this is because researchers around the world are trying to find possible alternatives that can work for students to have a paradigm shift from the face-to-face method of learning to online education due to the closures of schools in many parts of the world. A few other studies have been focused on the impact of COVID-19 on the performance of students (Keefe, 2020; Schiariti, 2020; Sintema, 2020). While this is happening in education, every other sector has been affected by the impact of COVID-19. For instance, it is not surprising that many research scientists and preventive medicine specialists in the medical field (e.g., Abdulmir & Hafidh, 2020; Paterson, 2020), are also in the laboratories trying to investigate a medical solution to

this global pandemic. Economists are calculating and predicting models which are sending shocks through the global economy (Kraemer et al., 2020). Therefore, the aim of this study is to explore how prospective teachers at the Copperbelt University (CBU) engage in online learning mathematics activities in the age of COVID-19. This study is primarily important to the Copperbelt University as it offers relevant information to transition from physical classroom based mathematics learning to online learning as a potential response to COVID-19. The results of this study could be used to propose that CBU management should implement a comprehensive and advanced pedagogic design to render mathematics lessons through virtual classrooms during and beyond the COVID-19 age. On a broader perspective, this study contributes to existing literature in the field of Mathematics Education which other scholars could use in relation to the global pandemic. This study might also be interesting for the Ministry of Higher Education as it provides relevant information to the ministry to prepare to combat and contain the impacts of COVID-19 on the Zambian education in general. It is hoped that when COVID-19 resolves, transition is likely to take place in the way e - learning will be used in Mathematics Education, particularly with the utilization of digital devices.

Grigg(2016), carried out a thesis for master of education at Edith Cowan University entitled, "Evaluating the Effect of the Digital Divide between Teachers and Students on the Meaningful Use of Information and Communication Technology in the Classroom". The purpose of the study was to investigate whether differences in ICT competence between teachers and their classes affected the extent to which meaningful use of ICT was used in their classes and other the study sought to identify whether any such digital divide would be reflected in the Meaningful Use of ICT in the class. The sample of students comprised a class of students (from either Year 7, 8 or 11) from each of the teachers, totaling 154 students. The selection of the Year groups was dependent upon the availability of the teacher. The samples of teachers and students were all from the same school. In conclusion, this study has demonstrated that the ICT competence of the teacher, when compared with the competence of his/ her students, is likely to have an effect on the Meaningful Use of ICT in the classroom. Higher levels of the Meaningful Use of ICT were apparent when the Digital Divide was in favor of the teacher. However, even when the Digital Divide was in favor of the teacher, the rating of the Meaningful Use of ICT was only

at the Developing level. Emphasizes that even when the Digital Divide is in favor of the teacher, it does not guarantee a high level of Meaningful Use of ICT in the classroom. Further research would benefit schools in understanding how to support teachers to improve the use of ICT in the classroom. The findings of this study would suggest that a first step in improving the use of ICT in classrooms would be to ensure teachers have a level of ICT competence at least commensurate with the average 82 student in their classes. To achieve this, ongoing professional learning and support for all teachers would be required.

### **Research Gap**

A research gap or a literature gap refers to such unexplored or underexplored areas that have scope for further research.

Overall review of related literature shows digital divide and online learning in mathematics education is very important to make mathematics learning effective and sustainable. Using locally available instructional materials and examples can increase the student's interest towards

During my literature review, I founded a lot of researches were done on digital technology, digital divideonline learning in mathematics related to different areas. But I didn't find any research done to explore the digital divide and online learning in mathematics education. I founded the gap there. So, through this research I was going to find out the existing situation of digital divide in ..... districtand explore the challenges and opportunities of online learning in mathematics education and their pedagogical implication in the mathematics class room.

### **Theoretical Review**

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 literature, a number of theories have been developed from different perspective. The information has obtained from different literature is sorted under the main themes and stories.

## **Connectivism Theory**

The latest contender in educational theory has been termed 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 Connectivism explains that how technologies have created new opportunities for people to learn and share information across the World Wide Web and among themselves. These technologies include web browsers, email, wikis, online discussion forums, social networks, YouTube and any other tool which enables the 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 learning that is networked. The thesis 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, para. 1). Connectivism is characterized as a reflection of our society that is changing rapidly. Society is more complex, connected socially, global, and mediated by increasing advancements in technology. Rather than a new learning theory, connectivism offers an educator a model or mental representation that depicts 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 ability 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 us (within an organization or a database).'

Siemens (2005) identifies the 8 principles of connectivism as follows:

- Learning and knowledge rests in diversity of opinions.
- Learning is a process of connecting specialized nodes or information sources.
- Learning may reside in non-human appliances.
- Capacity to know more is more critical than what is currently known
- Nurturing and maintaining connections is needed to facilitate continual learning.
- Ability to see connections between fields, ideas, and concepts is a core skill.
- Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.
- Decision-making itself a learning process. Choosing what to learn and the meaning of incoming information is seen through the lens of a shifting reality. While there is a right answer now, it may be wrong tomorrow due to alterations in the information climate affecting the decision.

Connectivists 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 their own personal 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 thesis 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 connectivism implies:

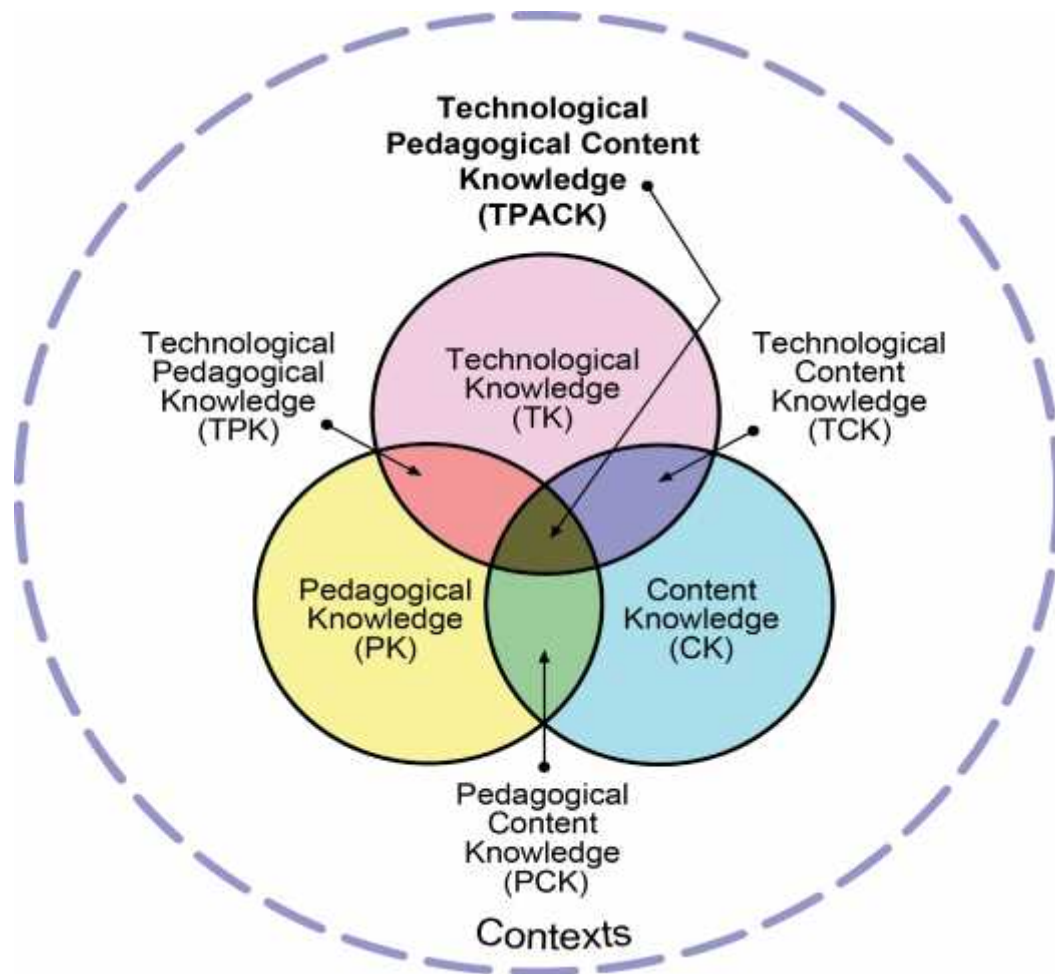
(a) Seeks to describe ‘successful’ networks (as identified by their properties, which I have characterized as diversity, autonomy, openness, and connectivity) and

(b) seeks to describe the practices that lead to such networks, both in the individual and in society – which I have characterized as modelling 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 inter-connected with myriad other networks.

### **Technological Pedagogical Content Knowledge (TPACK)**

In 1986, Shulman developed a new way of looking at teachers’ knowledge through a construct that he called the pedagogical content knowledge (PCK). Shulman (1986) described the pedagogical content knowledge (PCK) as a particular content knowledge that goes beyond knowledge of subject matter. According to Shulman, PCK in the field of teaching involves “the most useful forms of representations of those ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations” (p. 9). Additionally, Shulman argued that a teacher must be aware of students’ misconceptions and how to fix them, besides being familiar with what makes learning easy or difficult for them. Shulman also described content knowledge as the organization of knowledge in the mind of the teacher that “goes beyond knowledge of facts of concepts of a domain...but requires understanding the structures of the subject matter” (p. 9). As a consequence, using Shulman’s conception of PCK, Mishra and Koehler (2006) developed the TPCK theoretical framework, which was later renamed TPACK (Thompson & Mishra, 2007) to illustrate how teachers’ understanding of technology and pedagogical content knowledge (PCK) interact to develop effective teaching practices that incorporate technology.



**Figure 2.1: A Conceptual Model for TPACK ()**

In their model, Mishra and Koehler described three components to knowledge: content, pedagogy, and technology that intersect to display TPACK. These components created the elements of the TPACK construct – pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), content knowledge (CK), pedagogical content knowledge (PK), technology knowledge (TK) and the technological pedagogical and content knowledge (TPACK) (Mishra & Koehler, 2006). In mathematics education, researchers using TPACK have mainly concentrated in the United States and have focused on pre-service secondary teachers (e.g., Landry, 2010; Niess, 2006; Schimdt, Baran, Thompson, Mishra, Koehler & Shin, 2009). Significantly fewer studies involving in-service teachers have been conducted using TPACK theoretical framework in mathematics education (e.g., Archambault & Crippen, 2009). However, the TPACK theoretical framework has been used by various researchers in various educational disciplines in ICT integration. One of the strengths of TPACK theoretical

framework has been on teacher assessment and evaluation. In mathematics education, for example, Landry (2010) developed a survey instrument for validating middle school teachers' mathematics technological pedagogical content knowledge (M-TPACK). The study supported teachers' in-service training to understand the role of technology in mathematics teaching. Other studies have also developed survey instruments to study teachers' TPACK. For example, Archambault and Crippen (2009) developed a survey instrument to measure TPACK for K-12 online teachers. The findings indicated that teachers felt confident about their content knowledge, pedagogical knowledge, and pedagogical content knowledge. However, teachers felt incompetent when it came to the domain of technology. Schimdt et al. (2009) developed a survey instrument to measure TPACK for pre-service teachers. They claimed that the instrument could help teacher educators in designing appropriate longitudinal studies to assess pre-service teachers' development of TPACK. The TPACK theoretical framework has not been without criticism for varied reasons. Originating from Shulman's initial conception of PCK, several researchers have raised concern about the relationship between content knowledge and pedagogical knowledge (McEwan & Bull, 1991; Segall, 2004). These researchers have argued that it is not easy to think about content knowledge without thinking about pedagogical knowledge. This problem based on Shulman's notion of PCK has persisted to the TPACK theoretical framework. On one hand, the TPACK theoretical framework looks fancy both in text and graphics; however, its complexity to comprehend and apply it in educational settings has been faulted (Archmbault & Barnett, 2010) because the relationship between content, pedagogy, and technology has not been clearly understood by researchers and educational practitioners. On the other hand, Cox (2008) highlighted that TPACK theoretical framework lacks implementation and evaluation strategies, and the boundaries to the constructs are not distinguishable. In fact, considering professional learning for teachers, TPACK fails to clarify the knowledge teachers need to know about content, pedagogy, and technology (Harris, Mishra & Koehler, 2009). In agreement, Jimoyiannis (2010) argued that TPACK needs to be rebuilt so that the distinction between the content, pedagogy, and technology may be clarified and the role of tool affordances and limitations of constraints are elaborated.

## Conceptual Framework

A conceptual Framework is visual or written representation either graphically or in narrative form that explain either graphically or in written form, the main concepts and variables and their presumed relationship with each other (Khanal, 2019). Conceptual framework is also known as the map or travel plan of the research study. The conceptual framework of this study is given as the figure below.

## Conceptual Framework

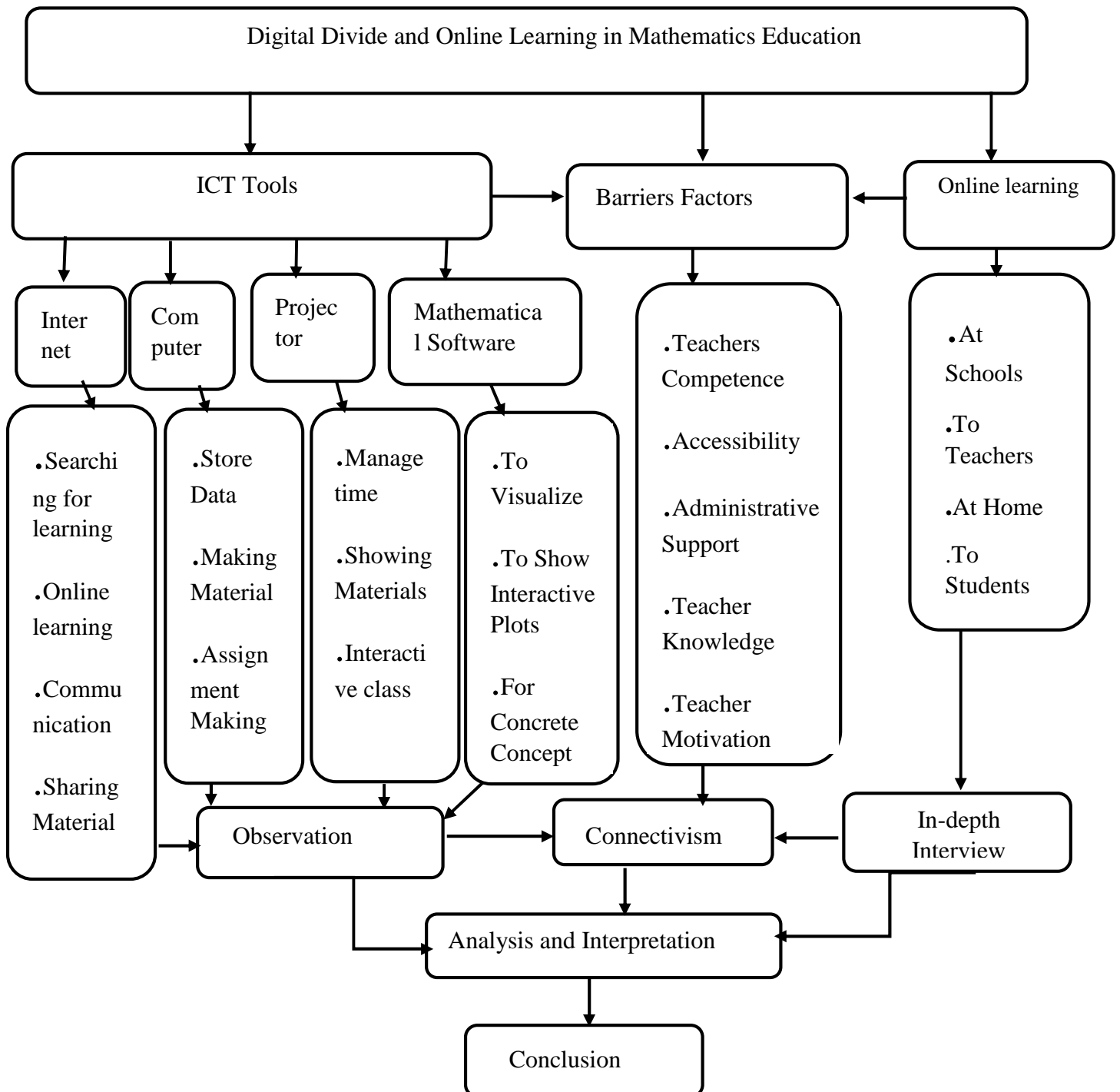


Figure 2.1: Conceptual Framework of the Study

## **CHAPTER-III**

### **RESEARCH METHODOLOGY AND PROCEDURES**

Research methodology and procedure is a guideline that helps the researcher collect and analysis data.

A research methodology tells you what you have to do, to manage your projects from start to finish. It describes every step in the project life cycle in depth .So you know exactly which tasks to complete, when and how .Whether you're an expert or a novice, it helps you complete tasks faster than before (Eves, 1983).

Research Methodology is path through which the researcher needs to conduct their research. This chapter provides the clear and concrete direction to answer the research question and to attain the objectives of the study. This chapter is deals with the topics Design of the Study, Area of Study, Respondents of the Study, Sampling Procedure, Data collection tools, Quality standards of the data collection tools, Data collection procedures, Data analysis and interpretation, Ethical Consideration.

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

The research design is detailed plan of investigation and the blue print of the research work. The researcher selects the research design to answer the research question objectively, rapidity and economically as it possible (Singh, 2008, p.450)

Since, it was an explanatory study my research was guided by qualitative research. Qualitative research is a form of inquiry that explores phenomena in their natural setting and uses multi-methods to interpret, understand, explain and brings meaning to them.

Qualitative research is a generic term for a variety of research approaches that study phenomena in their natural settings, without predetermined hypotheses .It has several characteristics such as naturalistic enquiry ,context specific ,human-as-instrument, emergent design ,inductive analysis, descriptive data, personal contact and insight, unique case orientation, empathic neutrality ,dynamic systems.(Khanal,2074)

The qualitative research design is a research method used extensively by scientists and researchers studying human behavior, opinions, themes and motivations. According to Creswell (2004), there are five different types of qualitative

research, which are phenomenology, grounded theory, ethnography, narrative inquiry, action research and case study.

The design of this study was descriptive and qualitative in nature. Descriptive and Qualitative research design or approaches could be based on their function, characteristics or disciplinary perceptiveness. One's Selection of research design was determined by how well full investigation of the particular research questions.

This was concerned with the study about "Digital Divide and Online Learning in Mathematics Education". To attain to purpose of this research, I would use the Qualitative study as the design of the study because in qualitative study the data was collected through direct observation in natural setting and the actual incidence on the field. "Digital Divide and Online Learning in Mathematics Education" as an event is a case of the study and education officers, mathematics teacher, students were respondents.

### **Area of Study**

The area of this study was concerned with the Government school of Bajhang district in Nepal. To find out the existing situation of digital divide in Bajhang district and explore the challenges and opportunities of online learning in mathematics education, was the qualitative study whereas schools of five rural municipalities in Bajhang district was purposively selected as the area of this study.

### **Respondents of the Study**

This study was based on qualitative inquiry. So, the population and sample of this study not fixed. There is no any rule for selecting sample in qualitative inquiry (Anderson, 2011: Cited as Paneru, 2015). So, the sample size of the study depended upon the researcher what s/he wanted, what was the purpose of the study, credibility of the study and available of time and resources.

The population of this study would be all the mathematics teachers, head teachers, education officers and students of Government school in Bajhang district. I selected the schools of five rural municipalities in Bajhang district as my study site and the education officers, mathematics teachers and students of such study sitewere selected by purposive sampling method.

### **Sampling Procedure**

This was qualitative research design. So, I would select the Population and Sample for this study by non-probability Sampling. Guba and Lincoln (1981) stated that in qualitative research, Sampling is almost never representative or random but purposive, intended to exploit competing views and fresh perspectives as fully as possible (as cited by Khanal 2019, p. 130).

### **Data Collection Tools**

Data collection was an important part of the study and tools were important factors for data collection. To attain the objectives and get the responses of research questions, the researcher gathers the data by using such tools. There are many tools for the qualitative research to get the information from the respondents and the study site. In this study, the researcher intended to find out the existing situation of digital divide in Bajhang district and explore the challenges and opportunities of online learning in mathematics education. For this study the researcher used Interview Schedule and Observation were main tools/instruments for data collection.

### **Interview schedule**

The interview was data collection tool which provides the basic and personal information towards anything. It's also known as an oral questionnaire. According Lokesh Koul, "Interview is process of communication in which the interviewee gives the needed information verbally in the face to face situation". The purpose of interview was not only to collect the superficial details about the interviewee but also prove the inner life of the interviewee. To obtain the data for this study, the researcher would conduct the in-depth and un-structured interview with education officers of five rural municipalities, mathematics teachers and students of the research site.

### **Observation Check List**

Observation was an activity of a living being, such as human, which was necessary in order to give knowledge of the environment through the senses which often later involve the recording of data via the use of scientific instruments. The observation checklist included coded items on the condition of the items. Observation checklist enabled the researcher to obtain first-hand information on the ICT facilities in the schools to find out the existing situation of digital divide in Bajhang district and

explore the challenges and opportunities of online learning in mathematics education in Bajhang district.

### **Quality Standards**

Reliability and validity of data collection tools was essential characteristics for effectiveness of data collection procedures. Reliability was the degree of consistency that the instruments or the procedure and validity is that quality of data collection of data collection tools that enables what is supposed to measured. Reliability is necessary but not sufficient condition for validity. In interviews, inferences about the validity are made to often on the basis of face validity (Cannell and Kahn, 1968). The most practical way of achieving greater validity was to minimize the amount of bias as possible. The purpose of interview was to find out what is in or on some one's mind and the purpose of open- ended interviewing is not to put things in some owns mind but to assess the perspectives of the person being interviewed. Validity was greater when the interview was based on carefully designed structure, thus ensuring that the significant information was elicited. The critical judge of the experts in the field of inquiry is helpful in selecting essential questions (Best and Kahn, 2009).

Similarly the validity observation is ensuring the internal validity of observation and minimization of biasness. The internal validity is the degree to which observed differences the dependent variable (Gray etal, 2012).

### **Data Collection Procedure**

One of the most important and essential step of the research study was data collection. To collect the data the researcher would go to the study site by administrating the interview guideline for education officers, mathematics teachers, head teachers, students, parents and observation note to observe the existing situation of digital divide in Bajhang district and explore the challenges and opportunities of online learning in mathematics education in Bajhang district. So, the researcher established the rapport to the rural municipality authority, the school authority and the mathematics teachers by introducing the researcher himself and stating the purpose and process of the research. On the basis of the purpose of the study, the researcher requested with the rural municipality authority and the school authority for to analyze the the existing situation of digital divide in Bajhang district and explore the

challenges and opportunities of online learning in mathematics education in Bajhang district. After that the researcher asked the permission and after getting permission the researcher moved towards education officers, mathematics teachers and students.

To obtain the objective of the study, the researcher would conduct the in-depth interview with education officers of five municipalities, head teachers, mathematics teachers, and students with the help of interview guideline. The conversation of those participants would be recorded by mobile phone or be written in note copy to get the originality and neutrality of the data. Similarly, the researcher observed the ICT lab to observe the facility of ICT tools and materials, mathematics classroom to know about the existing situation of digital divide in Bajhang district and explore the challenges and opportunities of online learning in mathematics education in Bajhang district. Also, the researcher would use the data from secondary resources from previous researches, Books, Articles, Newspapers and so on.

### **Data Analysis and Interpretation**

Data analysis was considered as the important step of the research study. After collecting the data using different relevant tools and techniques, the next logical step was to analyze and interpret data with a view arriving at empirical solution of the problem (Singh, 2009). According to Khanal (2019), "After collecting the data, the collected data can be analyzed on the basis of organizing the data , coding and recoding the data, building the theme, reporting and finding procedure".

After collection the data from selected sample using interview guidelines and observation check list. I would analyze and interpreted the data. This study was limited into qualitative research therefore the major part of data analysis would be based on descriptive analysis. The data collecting from interview and observation would be analyzed descriptively on the basis of conceptual framework. To analyze the collected data, I would follow the procedure organize the data, editing the data, coding and recoding the data, building theme, reporting and finding procedure. Firstly, I would organize and edit the data. After that, I would generate the different code according to the response of participants and also recoding the data according as similarities. After coding and recoding the data I would develop the themes and reporting the finding. Finally the data would be analyzed and interpret on basis of my conceptual framework.

## **Ethical Considerations**

The qualitative research frequently concerned with the individual cases and unique instances which might involve the personal sensitive matters, it raised the question of identity, confidence and privacy of the individuals. Ethics referred to well based standards of right and wrong that prescribe what humans ought to do, usually in terms of rights, obligations, benefits to society, fairness, or specific virtues (Velasquez, Andre, Shanks, & Meyer, 2008). In the research work the numerous ethical norms and values should be considered in order to make standardization in the data collection procedures and analyzing the data in qualitative research design. The ethical considerations of this research study were

**Institutional/Official Approval.** The researcher had the granted permission from institutions/offices prior to planning or conducting the research work.

**Informed Consent.** Informed consent means that the participants in the evaluation were fully informed about the evaluation being conducted. Participants needed to be aware of the purpose of the study, what group were funding it, how the finding would be used. Before participating the interview the objectives and the procedure of the study were verbally explained to each participant individually.

**Voluntary participation.** Participants took part in the time of research voluntarily.

**Do no harm.** This research couldn't harm the participants and their privacy.

**Confidentiality.** Confidentiality means keeping the information secreted. To ensure the Confidentiality, codes were used instead of the participant's names during the interview if the matter was very confidential.

## CHAPTER - IV

### ANALYSIS AND INTERPRETATION

In this unit I have tried to carry out the existing situation of digital divide in Bajhang district and explore the challenges and opportunities of online learning in mathematics education in Bajhang district after conducting my qualitative research for two months in the research site (Schools of five municipalities of Bajhang district). Where I observed the situation of ICT tools, situations of digital divide and online learning activities of the mathematics teachers and students, took their in-depth interview and read some related documents prescribed by education officers of rural municipalities. After assessing trustworthiness by doing triangulation between the data collected from interviews, observation and document analysis, I have analyzed and interpreted the obtained information under the following main theme.

I had included responses of nine participants for this qualitative study. Five education officers of Rural Municipalities were Basu, Dhurba, Rajendra, Baburam and D.R. Lamichhane (Pseudonyms). Two secondary math teachers were Raju and Aasha (Pseudonyms). Two students of secondary level were Kanchana and Pratik (Pseudonyms). I had selected nine respondents to represent all responses of study site.

Participant no. one is Kanchana (a Female), who is the student of class 10 at Bajhang, Nepal. She has studied in that school since class ECD. I asked her according to Appendix 1. She said "*I have one Smartphone belongs to father, a radio and a TV. I have no desktop computers/laptop at my home. I haven't internet access at my home. Taking data from mobile network is too expensive. So, I am not allowed use data from mobile network. I don't have internet access at home. If internet access chance is given to me, I will find information, will complete school work, will watch YouTube, will search study materials and will communicate to others. My technology skills are as follows. My typing is fair, using a Smartphone is fair, using tablet/iPad is poor, creating videos is fair, making video calls is excellent, taking pictures is excellent, using YouTube is fair, using social media is fair, sending/receiving email is poor.*

*I haven't taken online class in mathematics subject. I have taken few digital classes about science and social in my school. I felt online class was needed in Corona Pandemic time. I hadn't taken online classes in Corona Pandemic. I didn't*

*have online class in that time because our school couldn't run online classes due to lack of ICT Tools facility. Our school has 10 computers, 1 laptop, 1 projector and internet access with low network capacity. Computers, laptops, projectors and network access are not enough for all students and teachers.*

*In our village, 90% villagers don't have computers and laptops. 95% villagers don't have internet access due to lack of economy and due to internet access availability in village. Government offices, organizations and only rich family have only internet access. So, Digital Divide exists clearly. There are many challenges for running online learning in mathematics education such as there is not enough internet access in the school, there is not enough laptops and computers with high capacity for running online classes. Specially most of the students don't have ICT tools such as Laptops, computers, internet, and digital literacy.etc. About 95% students have Smartphone in their family but they can't afford internet access due to lack of government facility or due to so expensive. Taking mobile data is not affordable because most of the villagers are poor. Due to lack of digital literacy in teachers, parents and students, online learning in mathematics education is not easy. There is electricity facility if government gives laptops to every teacher and student, gives the internet access, gives the training to students and teachers for increasing digital literacy, digital divide will be bridged in new situation such as Corona Pandemic time."*

From the responses of participant no. One Kanchana, It was seen cleared that she had digital tools such as one smart phone, a radio and a TV only at her home. She didn't have laptop/computer, tablet and Ipad. Her home didn't have internet access. Only one Smartphone was not enough to use for their family. Taking mobile data was not allowed to her because her family couldn't afford that. She had medium technological skills. She hadn't taken online class in mathematics subject. She had taken few digital classes about science and others in her school. She hadn't taken online classes of any subjects in Corona Pandemic time. Her school didn't run online class in corona pandemic time due to lack of ICT Tools facility. Her schools had not enough computers, laptops, projectors and network access to teachers and students. 90% of her villagers' family didn't have computers/laptops due to lack of economy. 95% of her villagers' family didn't have internet access due to lack of economy and lack of network access availability of government. Government offices, organizations

and only rich family were able to keep internet access. According to her, there were digital divides existed. It should be bridged for online classes in the future.

Participant no. two is Pratik (a male), who is the student of class 8, Bajhang Nepal. He has studied in that school since class ECD. I asked to him according to Appendix 1. He said " *I have one Smartphone belongs to father. I have no desktop computers/laptop, no radio, no TV, no IPad, no Tablet, at my home. I haven't internet access at my home. There are six members in my family. One Smartphone is not enough for all family. Four of us are students, so we can't use Smartphone for our classes. Taking data from mobile network is too expensive. So, I am not allowed use data from mobile network at my home. I don't have internet access at home. If internet access chance is given to me, I will find information, will complete school work, will watch YouTube, will search study materials and will communicate to others.*

*My technology skills are as follows. My typing is fair, using a Smartphone is fair, using tablet/IPad is poor, creating videos is poor, making video calls is fair, taking pictures is excellent, using You Tube is poor, using social media is fair, sending/receiving email is poor. I haven't taken online class in mathematics subject. I haven't taken any digital classes in my school. I felt online class was needed in Corona Pandemic time. I hadn't taken online classes in Corona Pandemic. I didn't have online class in that time because our school couldn't run online classes due to lack of ICT Tools facility and lack of digital literacy. Our school has 5 computers, 1 laptop, and internet access with low network capacity. Computers, laptops, projectors and network access are not enough for all students and teachers.*

*In our village, 99% villagers don't have computers and laptops. 100% villagers don't have internet access due to lack of economy and due to internet access availability in village. Government offices and organizations have only internet access. So, Digital Divide exists clearly. There are many challenges for running online learning in mathematics education such as there is not enough internet access in the school, there is not enough laptops and computers with high capacity for running online classes. Specially most of the students don't have ICT tools such as Laptops, computers, internet, smart phones, and digital literacy.etc. About 50% students have Smart phones in their family but not enough for them due to no. of family members. They can't afford internet access due to lack of government facility or due to so expensive. Taking mobile data is not affordable because most of the*

*villagers are poor. Due to lack of digital literacy in teachers, parents and students, online learning in mathematics education is not easy. There is electricity facility if government gives laptops, desktop computers, projectors, digital white boards, internet access with high capacity, gives digital lab to the school, gives laptops to every teacher and student, gives the internet access, gives the training to students and teachers for increasing digital literacy, digital divide will be bridged in new situation such as Corona Pandemic time."*

From the responses of participant no. two Pratik, It was seen cleared that he had digital tools such as only one smart phone at his home. He didn't have laptop/computer, tablet, radio, TV and Ipad. Four of them of family members at six members of his family were students; One Smartphone was not enough for all family for their classes. His home didn't have internet access. Only one Smartphone was not enough to use for their family. Taking mobile data was not allowed to him because his family couldn't afford that. He had poor technological skills. He hadn't taken any online classes in his school. He hadn't taken online classes of any subjects in Corona Pandemic time. His school didn't run online class in corona pandemic time due to lack of ICT Tools facility. His schools had not enough ICT tools such as computers, laptops, projectors and network access to teachers and students. 99% of his villagers' family didn't have computers/laptops due to lack of economy. 100% of his villagers' family didn't have internet access due to lack of economy and lack of network access availability of government. Government offices and organizations were able to keep internet access. According to him, there were digital divides existed. It should be bridged for online classes and digital classes in the future.

Participant no. three is Raju (a male), who is the secondary mathematics teacher at , Bajhang, Nepal. He has taught in that school since 2014A.D. He has been teaching since 2005 A.D. I asked to him according to Appendix 2. He said "*I have one Smartphone and one laptop at my home. I don't have internet access at my home. I don't have internet access at my school. I use few ICT tools in classroom to show mathematical shapes, to show mathematical procedure, to show mathematical document with the help of offline material. I use the internet to send/receive emails, to find information, to teach online classes, to watch YouTube, to communicate with others, to search teaching materials, to download the videos related to teaching, took teaching tutorials.*

*I don't have enough digital literacy. So, I use the internet in that way. I haven't taken online classes in mathematics. In reality I can't take online classes due to lack of digital literacy. I have taught few offline digital classes. I have heard about Mathematical specialists software such as Computer Algebra System (CAS), Dynamic Geometry System (DGS), Matrix Laboratory (Mat Lab), Statistical Package for the Social Sciences (SPSS) but I never use them. I can't teach mathematics digitally in classroom because of lack of digital literacy and lack of digital facilities. In our school, there are 7 computers, 1 laptop, 1 photocopy, 1 scanner and 1 camera. There is no internet access due to lack of availability of government facility. Projectors and digital lab are not in my school. All the teachers have low digital literacy. Most of the parents of our students are not well educated. So, most students have low level of digital literacy. In school service area, there is no internet access. I guess 98% students don't have ICT tools such as laptops, computers, and internet access. About 85% students have smart phones in their family but no. of smart phones is not enough for their family because of more members in their family. The economy of parents of our students is not high. So, they can't buy mobile data for their children's online education. It shows that digital divide exists clearly.*

*There are many challenges of online learning in mathematics education in our school. Our school has no internet access, has no projectors, has no enough laptops, has no enough computers, has no digitally educated well trained teacher in our school and has no government help about digital class. Especially our students are far from the digital world. So, online learning in mathematics has many challenges. I guess most schools of Bajhang district have same our problems. I haven't taken online mathematics class in Corona Pandemic time. I felt that if online class was there, students would get classes regularly. This world must face different types of Pandemic time such as COVID -19, earthquake of 2072 B.S., etc. So, our government must give every facility to school for digital classes. Such as high capacity internet access, enough computers, laptops, projectors, digital lab, regular expenses of digital field of our school and gives digital literacy training to each teachers of our school. Not only this, government must give the laptops or tablets to each teacher and students, must give the internet access with high capacity to every part of Bajhang with low price, must give the training for improving digital literacy to everyone. After that digital*

*divide will be bridged in new situation and online class for all subjects will be successful in the future."*

From the responses of participant no. three Raju, It was seen cleared that he had digital tools such as one smart phone and one laptop at his home. His home/school didn't have internet access. He had medium technological skills. He hadn't taken any online classes in his school. He hadn't taken online classes in Corona Pandemic time. But he had taken offline some digital classes about mathematics. He didn't know about any mathematical software. In his school, there were few computers, laptops, scanners, etc., which were not enough. But his school didn't have internet access, didn't have digital lab and projectors. It means his school was unable to run digital and online class. Students and teachers of his school had low level of digital literacy. Parents' of his students were not well educated and not well capable for expenses of their children. In school service area, there was no internet access due to lack of network unavailability of government. 98% students didn't have ICT tools such as laptops, computers, tablets, etc. 85% students had Smartphone in their family but no. of Smartphone was not enough for their family because of more members in their family. Taking mobile data was not affordable due to lack of economy. There were many challenges for running online classes. Digital tools, ICT tools, digital literacy trainings, etc would be supported by government. Digital divide must be bridged with the support of government long term plan for the future.

Participant no. four is Asha (a female), who is the secondary mathematics teacher at , Bajhang, Nepal. She has taught in that school since 2010 A.D. She has been teaching since 2000 A.D. I asked to her according to Appendix 2. She said "*I have One Smartphone, One I phone, one Desktop computer and one laptop at my home. I have internet access at my home. I have given one laptop by school for school work. Our school has internet access with good quality. I use some ICT tools in classroom. I can take online class but I don't take online class because our students are unable to take online classes due to lack of ICT tools and lack of internet access. I have taught digital class in my subjects by using internets and normal offline software. I can use projector in the classroom.*

*I use the internet to send/receive emails, to find information, to teach online classes, to watch YouTube, to communicate with others, to search teaching materials,*

*to download the videos related to teaching, to look teaching tutorials, etc. I have heard about Mathematical specialists software such as Computer Algebra System (CAS), Dynamic Geometry System (DGS), Matrix Laboratory (Mat Lab), Statistical Package for the Social Sciences (SPSS) but I never use them. I can teach few topics on mathematics digitally in classroom because of medium level of digital literacy. In our school, there are 60 computers, 30 laptops, 5 photocopies, 3 scanners and 20 projectors. There is internet access with good quality. Digital lab will be made in near future in my school. Most of the teachers have low digital literacy. Most of the parents of our students are educated. So, most students have low level of digital literacy due to lack of ICT tools at their home. I guess 80% students don't have ICT tools such as laptops, computers, and internet access. About 98% students have smart phones in their family but no. of smart phones is not enough for their family because of more members in their family. The economy of most parents of our students is not high. So, they can't buy mobile data for their children's online education. It shows that digital divide exists clearly.*

*There are few challenges of online learning in mathematics education in our school. Our school has internet access good quality but it is not enough, has no enough computers for students, has no digitally educated well trained teacher in our school and has no government help about digital class. Especially our most of students are far from the digital world due to lack of digital tools, lack of ICT tools and internet access. So, online learning in mathematics has many challenges. I guess most schools of Bajhang district have more problems than ours because our school is Model school funded by Government. I haven't taken online mathematics class in Corona Pandemic time. I felt that if online class was there, students would get classes regularly. So, our government must give every facility to school for digital classes. Such as high capacity internet access, enough computers, laptops, projectors, digital lab, regular expenses of digital field of our school and gives digital literacy training to each teachers of our school. Not only this, government must give the laptops or tablets to each teacher and students, must give the internet access with high capacity to every part of Bajhang with low price, must give the training for improving digital literacy to everyone. After that digital divide will be bridged in new situation and online class for all subjects will be successful in the future."*

From the responses of participant no. four Asha, It was seen cleared that she had digital tools such as One Smartphone, One I phone, one Desktop computer and one laptop at her home. Her home/school had internet access. She had medium technological skills. She had medium digital literacy. She hadn't taken any online classes in her school but she could if students were able to take class. But she had taken offline some digital classes about mathematics. She hadn't taken online classes in Corona Pandemic time. She knew about some mathematical software but she couldn't use. She had taught digital class on few topics in mathematics. In her school, most of ICT tools, digital tools and net access are available with sufficient numbers because her school was Model school, was selected by Government. Most of students and most of teachers of her school had low level of digital literacy. Most parents of students of her students were educated but not well capable for expenses of their children. In school service area, there was internet access but most of students' family couldn't keep internet access due to lack of economy and network unavailability of government for few places. 80% students didn't have ICT tools such as laptops, computers, tablets, etc. 98% students had Smartphone in their family but no. of Smartphone was not enough for their family because of more members in their family. Taking mobile data was not affordable due to lack of economy. There were many challenges for running online classes to the students. Digital tools, ICT tools, digital literacy trainings, etc would be supported by government. Digital divide must be bridged with the help of government by long term plan for the future.

Participant no. five is Rajendra (a male), who is the, Bajhang Nepal. He has 4 years experiences in that post since 2017A.D. He was a mathematics teacher for 10 years. I asked to him according to Appendix 3. He said "*There are 12 Government school and 1 private school. Among government school, 3 of them are secondary, 3 of them are Basic Level and 6 of them are primary. There is only one Basic Level Private School. There are 905 students in government school and 255 students in private school. Three Secondary schools have computers and laptops but not enough numbers which they need and four Basic Level School have few desktop computers but not enough. Primary schools don't have computers. One secondary school has only 3 projectors others don't have. None of schools have digital white board. Three secondary schools have internet access with low capacity but others haven't. The internet access of schools of this Rural Municipality is not good because government*

*can't give the opportunity to keep the internet. So, most of schools can't keep internet access. Secondary Schools only of this Rural Municipality run some digital classes but not acceptable type. Seven schools have connected electricity but others haven't. None of schools have their own telephone because central government hasn't given telephone facility there.*

*Three schools are out of range of national radio but inside the range local F.M., eight schools are out of range of national T.V. but Dish Home, Kebul TV can give facility if school needs. None of schools run online classes. All school couldn't give online classes in Corona Pandemic time. Rural Municipality gives Rs. 12000 per year to government secondary schools for internet access since 2076 B.S. but others schools can't. If Basic Level and Primary schools keep internet access, they will pay themselves. Rural Municipality hasn't given laptops/ computers to the teacher for online teaching class. Rural Municipality hasn't given laptops/ computers to the students for online learning. Rural Municipality gives some fund to secondary school for digital technology but not regularly. Our teachers/students can't afford for online learning due to remote area. All schools can't run online classes due to lack of ICT tools, due to lack of internet access, due to lack of digital literacy in teachers and students.*

*All schools couldn't run online class in Corona Pandemic time. In this rural Municipality, there is no internet access belongs to Nepal Government. Some government office and organizations have connected internet by private company. So, schools and students' family are unable to connect internet access. Central government doesn't focus on online learning and give budget to every school. So, we are unable to give digital tools, ICT tools and other support to every school. Government hasn't made this rural municipality internet access friendly. This rural municipality has most poor families and few medium families according to economic status. So, students can't get digital technology facility. 98% of students' families haven't ICT Tools such as laptops/computers, etc. 75% of students' families have smart phones but no. of smart phones is not enough of their family. Most of teachers don't have ICT Tools such as laptops/ computers and internet access at their home. So, digital divides exist clearly. Central government must make clear long term policy to remove digital divide and give budgets to the schools, rural municipality, teachers*

*and students. After that, digital divide will be bridged in new situation and online class for all subjects will be successful in the future."*

From the responses of participant no. five Rajendra, It was seen cleared that his Rural Municipality had 12 Government schools and 1 Private school. The digital tools, ICT Tools and internet access facilities of schools of his Rural Municipality were not good. Teachers and students of his Rural Municipality had low digital literacy. Economic status of students' families wasn't not high, so they couldn't afford the required digital environment for their children. Online learning environment was not created.

Participant no. six is D.R. Lamichhane (a male), who is the education officer at Kedarsyu Rural Municipality, Bajhang Nepal. He has 4 years experiences in that post since 2017A.D. He was a Resource Person for 12 years. I asked to him according to Appendix 3. He said *"This Rural Municipality has 15 Government school and 4 private schools. Among government school, 2 of them are secondary, 5 of them are Basic Level and 8 of them are primary. Among private school, 2 of them are secondary, 1 of them are Basic Level and 1 of them is primary. There are 1595 students in government school and 845 students in private school. Two Government Secondary schools have enough computers and laptops and five Basic Level Government School have few desktop computers but not enough. Three primary schools have a few no. of computers but remaining five have no computers. Both secondary school has 5/5 projectors others don't have. Both Government secondary schools have digital white board others don't have. Government secondary schools, five Basic Level schools and three Primary schools have internet access with good capacity but others haven't. The internet access of schools of this Rural Municipality is good for most part because government gives the opportunity to keep the internet because the headquarter Dhunche of Bajhang district lies in this municipality. So, most of schools can keep internet access but few can't because of their location. Both Government Secondary Schools only of this Rural Municipality run some digital classes. Five government primary schools haven't connected electricity but others have. Both Government Secondary schools have their own telephone but others haven't.*

*Two schools are out of range of national radio but inside the range local F.M., five schools are out of range of national T.V. but Dish Home, Kebul TV can give facility if schools need. None of schools run online classes because of lack of students ICT Tools capacity but Both Government Secondary School can. All school couldn't give online classes in Corona Pandemic time. Rural Municipality gives Rs. 12000 per year to government secondary schools for internet access since 2076 B.S. but others schools can't get from government. If Basic Level and Primary schools keep internet access, they will pay themselves. Rural Municipality hasn't given laptops/ computers to the teacher for online teaching class. Rural Municipality hasn't given laptops/ computers to the students for online learning. Rural Municipality gives some fund to secondary school for digital technology but not regularly. Our teachers/students can't afford for online learning due to remote area and due to low economic status. All schools can't run online classes due to lack of ICT tools, due to lack of internet access, due to lack of digital literacy in teachers and students.*

*All schools couldn't run online class in Corona Pandemic time. In this rural Municipality, there is internet access belongs to Nepal Government but not in all part. Some government offices, rich family and organizations have connected internet by Government Company but most teachers and students are unable to connect internet in their home due to low economic status and cause of others. Some schools and students' family are unable to connect internet access. Central government doesn't focus on online learning and give budget to every school. So, we are unable to give digital tools, ICT tools and other support to every school. Government has to try to make this rural municipality internet access friendly. This rural municipality has most poor families and few medium families according to economic status. So, students can't get digital technology facility. 92% of students' families haven't ICT Tools such as laptops/computers, etc. 88% of students' families have smart phones but no. of smart phones is not enough of their family. Most of teachers don't have ICT Tools such as laptops/ computers and internet access at their home. So, digital divides exist clearly. In this municipality, most of students belong to bista family, school dropout rate is high, and awareness program should be run in different part of the village. Our teachers and students have low level of digital literacy. So, we must give them training for increasing digital literacy. Teachers and students are given laptops and internet access. If the central Government make long term plan for every school,*

*every teacher and every student for bridging the digital divide, then it will be bridged in new situation. After that online class will be run in every condition in the future."*

From the responses of participant no. six D.R. Lamichhane, It was seen cleared that his Rural Municipality had 15 Government schools and 4 Private schools. The digital tools, ICT Tools and internet access facilities of schools of his Rural Municipality were good but not enough. Teachers and students of his Rural Municipality had low digital literacy. Economic status of students' families wasn't not high, so they couldn't afford the required digital environment for their children. Online learning environment was not created.

Participant no. seven is Basu (a male), who is the education officer , Bajhang, Nepal. He has 4 years experiences in that post since 2017 A.D. He was a Resource Person for 14 years. I asked to him according to Appendix 3. He said "*This Rural Municipality has 15 Government school and 3 private schools. Among government school, 5 of them are secondary, 3 of them are Basic Level and 7 of them are primary. Among private school, 2 of them are secondary, 2 of them are Basic Level. There are 2475 students in government school and 1195 students in private school. Five Government Secondary schools have enough computers but laptops are not enough. One of the Government Secondary school has enough no. of laptops, which are given to each teacher. Three Basic Level Government School have few desktop computers and some laptops. All Government primary schools have a few no. of computers but not enough. Five Government secondary school has 3 or more projectors. Three Basic Level Government School have 1/1 projector. But Government primary schools haven't projectors. Two of Government secondary schools have digital white board others don't have. Five government secondary schools, three government Basic Level schools and four government Primary schools have internet access with good capacity but others haven't. The internet access of schools of this Rural Municipality is good for most part because government gives the opportunity to keep the internet because it is the developed part of Bajhang district. So, most of schools can keep internet access but few can't because of their location. All Government Secondary Schools three government Basic Level schools of this Rural Municipality run some digital classes. All government primary schools have connected electricity. Four Government Secondary schools have their own telephone but others haven't.*

*Two schools are out of range of national radio but inside the range local F.M., three schools are out of range of national T.V. but Dish Home, Kebul TV can give facility if schools need. None of schools run online classes because of lack of students ICT Tools capacity but All Government Secondary and Basic Level School can. All school couldn't give online classes in Corona Pandemic time. Rural Municipality gives Rs. 12000 per year to government secondary schools for internet access since 2076 B.S. but others schools can't get from government. If Basic Level and Primary schools keep internet access, they will pay themselves. Rural Municipality hasn't given laptops/ computers to the teacher for online teaching class. Rural Municipality hasn't given laptops/ computers to the students for online learning. Rural Municipality gives some fund to secondary school for digital technology but not regularly. Our teachers/students can't afford for online learning due to remote area and due to low economic status. All schools can't run online classes due to lack of ICT tools, due to lack of internet access, due to lack of digital literacy in teachers and students.*

*All schools couldn't run online class in Corona Pandemic time. In this rural Municipality, there is internet access belongs to Nepal Government but not in all part. Some government offices, rich family and organizations have connected internet by Government Company but most teachers and students are unable to connect internet in their home due to low economic status and cause of others. Some schools and students' family are unable to connect internet access. Central government doesn't focus on online learning and give budget to every school. So, we are unable to give digital tools, ICT tools and other support to every school. Government has to try to make this rural municipality internet access friendly. This rural municipality has most poor families and few medium families according to economic status. So, students can't get digital technology facility. 80% of students' families haven't ICT Tools such as laptops/computers, etc. 95% of students' families have smart phones but no. of smart phones is not enough of their family. Most of teachers don't have ICT Tools such as laptops/ computers and internet access at their home. So, digital divides exist clearly. In this municipality, our teachers and students have low level of digital literacy. So, we must give them training for increasing digital literacy. Teachers and students are given laptops and internet access. If the central Government make long term plan for every school, every teacher and every student for bridging the digital*

*divide, then it will be bridged in new situation. After that online class will be run in every condition in the future."*

From the responses of participant no. seven Basu, It was seen cleared that his Rural Municipality had 15 Government schools and 4 Private schools. The digital tools, ICT Tools, internet access facilities and digital environment of schools of his Rural Municipality were good. But the digital environment of students was not satisfied. Teachers and students of his Rural Municipality had low digital literacy. Economic status of students' family wasn't not high. So, they couldn't afford the required digital environment for their children. Online learning environment was not created.

Participant no. eight is Baburam (a male), who is the education officer at Bhairabnath Rural Municipality, Bajhang, Nepal. He has 4 years experiences in that post since 2017A.D. He was a Resource Person for 10 years. I asked to him according to Appendix 3. He said *"This Rural Municipality has 19 Government school and 1 private school. Among government school, 4 of them are secondary, 3 of them are Basic Level and 12 of them are primary. There is one private secondary school. There are 1795 students in government school and 275 students in private school. Four Government Secondary schools have enough computers but laptops are not enough. One of the Government Secondary school has enough no. of laptops, which are given to most teacher, which is Model school selected by Government. Three Basic Level Government School have few desktop computers. Three Government primary schools have a few no. of computers but not enough. But remaining nine hasn't. Four government secondary schools have 2 or more projectors. Three Basic Level Government School have no projector. Also Government primary schools haven't projectors. Two of Government secondary schools have digital white board others don't have. Four government secondary schools, three government Basic Level schools and three government Primary schools have internet access with good capacity but others haven't. The internet access of schools of this Rural Municipality is good for most part because government gives the opportunity to keep the internet because it is the developed part of Bajhang district. So, most of schools can keep internet access but few can't because of their location. All Government Secondary Schools, three government Basic Level schools of this Rural Municipality run some*

*digital classes. Five primary schools haven't connected electricity. One Government Secondary schools has its own telephone but others haven't.*

*Three schools are out of range of national radio but inside the range local F.M., five schools are out of range of national T.V. but Dish Home, Kebul TV can give facility if schools need. None of schools run online classes because of lack of students ICT Tools capacity but Two Government Secondary school can. All school couldn't give online classes in Corona Pandemic time. Rural Municipality gives Rs. 12000 per year to government secondary schools for internet access since 2076 B.S. but others schools can't get from government. If Basic Level and Primary schools keep internet access, they will pay themselves. Rural Municipality hasn't given laptops/ computers to the teacher for online teaching class. Rural Municipality hasn't given laptops/ computers to the students for online learning. Rural Municipality gives some fund to secondary school for digital technology but not regularly. Our teachers/students can't afford for online learning due to remote area and due to low economic status. All schools can't run online classes due to lack of ICT tools, due to lack of internet access, due to lack of digital literacy in teachers and students.*

*All schools couldn't run online class in Corona Pandemic time. In this rural Municipality, there is internet access belongs to Nepal Government but not in all part. Some government offices, rich family and organizations have connected internet by Government Company or have connected internet by private company but most teachers and students are unable to connect internet in their home due to low economic status and cause of others. Some schools and students' family are unable to connect internet access. Central government doesn't focus on online learning and give budget to every school. So, we are unable to give digital tools, ICT tools and other support to every school. Government has to try to make this rural municipality internet access friendly. This rural municipality has most poor families and few medium families according to economic status. So, students can't get digital technology facility. 90% of students' families haven't ICT Tools such as laptops/computers, etc. 90% of students' families have smart phones but no. of smart phones is not enough of their family. Most of teachers don't have ICT Tools such as laptops/ computers and internet access at their home. So, digital divides exist clearly. In this municipality, our teachers and students have low level of digital literacy. So, we must give them training for increasing digital literacy. Teachers and students are*

*given laptops and internet access. If the central Government make long term plan for every school, every teacher and every student for bridging the digital divide, then it will be bridged in new situation. After that online class will be run in every condition in the future."*

From the responses of participant no. eight Baburam, It was seen cleared that his Rural Municipality had 19 Government schools and 1 Private school. The digital tools, ICT Tools, internet access facilities and digital environment of schools of his Rural Municipality were not good. But the digital environment of students was not satisfied. Teachers and students of his Rural Municipality had low digital literacy. Economic status of students' families wasn't not high, so they couldn't afford the required digital environment for their children. Online learning environment was not created.

Participant no. nine is Dhurba (a male), who is the education officer Bitthadchir Rural Municipality, Bajhang Nepal. He has 2 years experiences in that post since 2019 A.D. He was a teacher for 5 years. I asked to him according to Appendix 3. He said *"There are 29 Government school and 1 private school. Among government school, 5 of them are secondary, 3 of them are Basic Level and 21 of them are primary. There is only one Basic Level Private School. There are 2795 students in government school and 225 students in private school. Two Government Secondary schools have enough no. of computers and laptops but remaining three Government Secondary schools have some computers and few no. of laptops which are not enough, which they need and three Government Basic Level School have few desktop computers but not enough. Ten Government Primary schools have few computer but others don't have computers. Three government secondary school has 2/2 projectors others don't have. None of schools have digital white board. Five secondary schools have internet access with low capacity but others haven't. The internet access of schools of this Rural Municipality is not good because government can't give the opportunity to keep the internet. So, most of schools can't keep internet access. Secondary Schools only of this Rural Municipality run some digital classes but not acceptable type. Twenty Government schools have connected electricity but others haven't. None of schools have their own telephone because central government hasn't given telephone facility there.*

*Ten schools are out of range of national radio but inside the range local F.M., Thirteen schools are out of range of national T.V. but Dish Home, Kebul TV can give facility if school needs. None of schools run online classes. All school couldn't give online classes in Corona Pandemic time. Rural Municipality gives Rs. 12000 per year to government secondary schools for internet access since 2076 B.S. but others schools can't. If Basic Level and Primary schools keep internet access, they will pay themselves. Rural Municipality hasn't given laptops/ computers to the teacher for online teaching class. Rural Municipality hasn't given laptops/ computers to the students for online learning. Rural Municipality gives some fund to secondary school for digital technology but not regularly. Our teachers/students can't afford for online learning due to remote area. All schools can't run online classes due to lack of ICT tools, due to lack of internet access, due to lack of digital literacy in teachers and students.*

*All schools couldn't run online class in Corona Pandemic time. In this rural Municipality, there is no internet access belongs to Nepal Government. Some government office and organizations have connected internet by private company. So, schools and students' family are unable to connect internet access. Central government doesn't focus on online learning and give budget to every school. So, we are unable to give digital tools, ICT tools and other support to every school. Government hasn't made this rural municipality internet access friendly. This rural municipality has most poor families and few medium families according to economic status. So, students can't get digital technology facility. 95% of students' families haven't ICT Tools such as laptops/computers, etc. 85% of students' families have smart phones but no. of smart phones is not enough of their family. Most of teachers don't have ICT Tools such as laptops/ computers and internet access at their home. So, digital divides exist clearly. Central government must make clear long term policy to remove digital divide and give budgets to the schools, rural municipality, teachers and students. After that, digital divide will be bridged in new situation and online class for all subjects will be successful in the future."*

From the responses of participant no. nine Dhurba, It was seen cleared that his Rural Municipality had 30 Government schools and 1 Private school. The digital tools, ICT Tools, internet access facilities and digital environment of schools of his Rural Municipality were not good. But the digital environment of students was not

satisfied. Teachers and students of his Rural Municipality had low digital literacy. Economic status of students' families wasn't not high, so they couldn't afford the required digital environment for their children. Online learning environment was not created.

## **CHAPTER - V**

### **FINDINGS, CONCLUSION AND IMPLICATION**

This chapter deals with the finding and conclusions. The first section reveals the major findings of the study; conclusions are derived on the basis of research analysis, reflections of the researcher of this research study and implications are kept at the end in the second section.

#### **Findings**

Bajhang district with area it has low no. of population. The villages and houses of people are scattered. There are few big landslides which displace the people habitants. The economic status of people of Bajhang district is low. Main economic source of people of Bajhang district is tourism, medicinal herbs like yarsagumba and international remittances. Low fertilized rate of agricultural land is not enough for people of Bajhang. Due to the implementation of Some hydro power projects, the people of the area have got the facility of electricity. the people there are happy because of the fear of the facility to some extent. During my two month qualitative research in my research site, I conducted in-depth interview and did observation where the main objective of my study were to find out the existing situation of digital divide in Bajhang district and explore the challenges and opportunities of online learning in mathematics education. And to find out the existing situation of digital divide in Bajhang district and explore the challenges and opportunities of online learning in mathematics education. I had selected schools of five Rural Municipalities of Bajhang district as the study site. Findings of my research work are as written below.

- There are 101 schools in Bajhang district. Among them 90 are Government and 11 are private.
- There are 24 secondary schools (19 Government and 5 private), 22 Basic Level Schools (17 Government and 5 private) and 55 Primary Schools (54 Government and 1 Private).
- Two municipalities have good condition of internet access but remaining three hasn't good condition.
- All 19 Government Secondary Schools get Rs 12000 annually for internet access by Central Government but other schools don't get.

- ICT Tools such as Computers, laptops, scanners, projectors, etc, are given to the Government secondary school and Government Basic Level Schools by the Rural Municipalities. But not Primary Schools don't get.
- No. of computers, laptops, projectors, scanners and other digital tools are not same condition in Government Secondary school in Bajhang district.
- No. of computers, laptops, projectors, scanners and other digital tools are not same condition in Government Basic Level school in Bajhang district.
- Digital literacy levels of teachers aren't same. Few of them have medium and some of them have low.
- Digital literacy level of students is very low because of unavailability of digital environment.
- 9565 students study in Government school and 2765 students study in private school in Bajhang district.
- 31 government primary schools don't have computers/laptops. Remaining 24 have computers/laptops.
- In primary school, computers are used for administration only for not teaching.
- In Basic level school, computers are used for teaching computer subjects.
- In Secondary school, computers are used for teaching computer subjects. Some school used for digital classes.
- None of schools run online classes in Corona Pandemic time.
- All schools haven't run online classes due to unavailability of student digital environment.
- 17 schools only have projectors but not enough numbers among 101 schools.
- 25 schools haven't connected electricity among 101 schools.
- Seven schools have their own telephones among 101 schools.
- 37 Government schools and 5 private schools have connected internet access among 101 schools but internet capacity is not same.
- 20 schools are out of range of national radios but are inside the range of local F.M.
- 34 schools are out of range of national TV but Dis Home, Kebul TV can give facility if school needs.

- Rural Municipality doesn't give laptop to the teacher and students personally for online learning.
- Rural Municipality gives ICT tools such as laptops, computers, projectors, etc to schools according to their budget.
- Rural Municipality doesn't give regular support to every school for the development of digital technology.
- 92.2% students don't have digital tools such as laptops/computers, tablets, etc.
- About 75% teachers don't have digital tools such as laptops/computers, tablets, etc.
- 86.6% of students' families have smart phones but no. of smart phones is not enough of their family.
- Mathematics teacher have low digital literacy. So, they don't use any mathematical software.
- Economic status of student family is not high. So, parents can't afford the desires of their children in digital technology.

### **Conclusions**

This study was conducted in Schools of five Rural Municipalities in Bajhang district. Among five Rural Municipalities Bajhang district, two of them are developed and three are developing. The basic facility such as electricity, internet access, telephones; roads, etc are not distributed equally. I had selected 9 respondents to represent whole Bajhang district, five of them are education officers of five rural municipalities, two math teachers and two students (One of class 10 and One of class 8). There is seen big digital divides between schools same rural municipality or different municipality. There is seen digital divide between teachers in same school or different school/ in same rural municipality or different municipality. There is seen digital divide between students in same school or different school/ in same rural municipality or different municipality. There is seen digital divide in the given support to the schools of Bajhang district. From analysis, there is seen digital divide in digital literacy. Most teachers and students have low digital skills. So, online learning is not possible in the schools of Bajhang district. Some teachers of Bajhang district can run online classes but students don't have online classes facility. So, online class is not running in Bajhang District. For online class both students and teachers get online digital environment but in Bajhang, it is not possible.

## Strategies on bridging the digital divide

The UN includes the reduction of the digital divide (SDG 9) in its Sustainable Development Goals. That is why; in many places initiatives have been launched to facilitate access to technology. Here we mention some of the most relevant ones:

- **Digital literacy programs.** They instruct people in less-favored areas of Internet use to improve their personal well-being.
- **Alliance for Affordable Internet (A4AI).** This project, led by an international coalition of governments, businesses and civil society, aims to lower the cost of broadband in specific areas in Africa, Asia and Latin America.
- **Free Basics.** This initiative, promoted by Facebook and six other technology companies, aims to provide free access to a number of websites through a mobile application.
- **Starlink.** This project, promoted by tycoon Elon Musk, is launching satellites into space to provide high-speed Internet and global coverage at affordable prices.

### How to Bridge the Digital Divide(Steele, 2018)

The digital divide is the discrepancy existing between different demographics on access to information technology. These populations can have unlimited, good enough, or inadequate access to IT. In this context, information technology encompasses the internet, computers, telephones, and televisions. Also falling under this bracket are any other gadgets related to information technology.

The digital divide also captures the ability of different populaces to leverage the internet, and various gadgets. Both governmental and private institutions, globally, have been fighting to narrow this divide.

The digital split arises from a plethora of social, geographic, and economic factors. Consequently, the cleave yields various penalizing consequences to the negatively affected population. The most severe percussions include social and economic exclusions of the affected populace.

## **How can we bridge the digital divide?**

As societies, we are faced with the hard question of ‘how do we bridge the digital divide?’ A menace which we should address as persons, communities, nations, and the world as a whole. Various initiatives we need to engage to narrow the digital gap under the various mentioned capacities include:

### **Increase digital literacy**

We have for such a long time had a narrow view of what digital literacy entails. Basically, most stakeholders confuse digital literacy and computer literacy. Computer literacy is the ability to use a computing device, together with its associated hardware and software components, and the internet.

Currently, there is no universally accepted definition of digital literacy. However, most entities agree that includes but not limited to computer, information, social media and network literacy. Understanding and implementing socio-economic, cultural, political, and behavioural aspects of digital literacy. Having good knowledge, skill, attitude, and behaviour towards networked devices. And, possession of both practical hardware and software skills.

Thus, in order to bridge the digital divide, we must improve our digital literacy capacities based on the above-listed parameters. Societies should come up with programmes to address the existing deficiencies across various age groups.

### **Provide operational incentives to information and communication technology entities**

There are various organizations fighting hard to narrow the digital divide. Sometimes, existing Laws and financial barriers thwart such efforts. Providing incentives relieves the burden encountered by such institutions. This responsibility especially lies with the existing governments.

A good example is a non-governmental institution focused on teaching SMEs how to integrate computing into their operations. A well-wishing government will chip in by minimizing the tax obligations of such institutions.

### **Develop relevant and local content in addition telecommunications infrastructure**

As individuals and communities, it is easier to learn and put in place concepts that we relate with. And how does this make it possible to bridge the digital divide? The target audience should directly relate to the benefits they will enjoy from digital literacy.

Take the example of a peasant farmer in some rural environment. How will investing in various skills associated with digital literacy influence him/her? What does he or she have to gain from such skills? How are they likely to streamline her daily activities and boost her status?

With digital literacy, the countryman/woman can realise ways to boost his/her farming. The farmer can easily discover better ways of tending crops. These benefits extend to even finding a good market for the farm produce, and much more. Furthermore, the farmer will soon discover how to make calculated risks through crop insurance. All such benefits are only workable in a digitally literate society.

### **Encourage the establishment of cyber clubs**

How do you bridge the digital divide by starting a cyber club? Deny yourself one or two luxuries which occasionally eat into your finances. Equally encourage your friends, families, and accomplices to follow in your footsteps. Consequently, channel the money you would have spent on the luxuries into one account. These funds should then be dedicated to spreading digital literacy. It could be for your kids or in support any disadvantaged community out there.

### **Establishment of workable partnerships between all information and communication technology stakeholders**

More information and communication technology stakeholders should join hands in abating digital divide. These institutions should frequently and jointly drive various campaigns towards promoting digital literacy. Furthermore, the campaigns need to include all factors increasing the digital divide. Especially access and positive use of information and communication technology.

### **Promote innovations geared towards overcoming the digital divide**

We need to replace ad hoc ways of doing things if we want to fast narrow the digital cleave. For example, in some developing countries, you will find every fiber company digging up separate tunnels to lay their cables. In other similar countries, internet companies keep digging up the same tunnel every other time to lay their cables.

What if such countries come up with a 'dig once' policy? Constructing single tunnels that can accommodate any other future investments. Thus reducing the cost of increasing the scope of cyber networks.

It is possible to bridge the global digital divide if we promote innovative ways of doing business.

### **Why is it important to bridge the digital divide?**

A technology used creatively creates a significant difference in a community. Economically, a citizenry can easily network, learn new business ideas, and transact.

A given population can discuss matters affecting them. They can make good political decisions as a country steering them towards success because only a few people are left in the dark.

The upcoming generation of students will experience better learning as they can better access and use various learning tools available on the internet.

Furthermore, the gap between the rich and the poor is likely to be narrowed. The poor, especially, will learn better ways of empowering themselves.

Overall, there are a plethora of benefits that come with bridging the digital divide.

### **What are some countries doing to bridge the digital divide?**

Developing nations are the ones world hit hardest by digital exclusion. Majority of these nations are investing in digital inclusion programmes. Both the young and the old can take advantage of such initiatives to educate themselves.

The United Nation, under its ITU docket, is also making some effort. 193 countries and 800 entities are currently members of the ITU. The International Telecommunication Union is improving access to ICTs by underserved communities. Such efforts are yielding fruits, reflected in the growing number of mobile broadband users in developing countries.

If the government gives same digital facility to every school, gives the internet access, makes the digital environment to the students, gives the training of digital literacy to teachers and students, then digital divide will be bridged. After addressing the challenges of online learning, online learning will be run in every situation in the future. Government must give the laptops or tablets to each teacher and students, must give the internet access with high capacity to every part of Nepal with low price, must give the training for improving digital literacy to everyone. Central government must make clear long term policy to remove digital divide and give budgets to the schools, rural municipality, teachers and students. The whole study emphasis that in the context of Nepal, it is utmost necessary to empower the teachers even students for their digital competency and the government should make the sustainable policy to provide ICT training and physical facilities for all in the educational sector.

In conclusion, this is the qualitative research in descriptive nature. I hope that this research will help to other researcher/students/users to get information for their work. Policy maker can take raw data to make policy for future. The educational implications to new comers, researchers and related to this study will be helpful. In making digital divide less situation and online class environment, this is one of the most useful study.

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## Appendix 1

### Questionnaire for interview to the student for completing the research entitled “digital divide and online learning in mathematics education”.

Name:

Class:

Name of School:

Location of School:

Location of Home:

I heartily request to the student, please give the answer.

**1. What devices do you have at home? Circle the devices that are available to you.**

- i) Smartphone                      ii) Tablet                      iii) iPad                      iv) Laptop  
 v) Desktop computer      vi) Gaming system      vii) Others

**2. Do you have Computer/ Laptop at home ?**                      Yes/ No

**3) Do you have internet at home ?**                      Yes/ No

**4) Are you allowed to use the internet at home ?**                      Yes/ No

**5) How do you use the internet? Circle the ways in which you use the Internet.**

- i) Play games                      ii) Find information                      iii) Complete school work  
 iv) Watch YouTube                      v) Communicate with others      vi) Search study materials

**6) Do you have taken online classes in mathematics or other subject?**      Yes/ No

**7) Do you have taken digital class in your school?**                      Yes/ No

8) How did you feel about online classes in Corona Pandemic time? .....

9) What is the existing situation of digital divide in your village and school? .....

10) What are challenges and opportunities of online learning in mathematics education?

11) How the situation of digital divide can be bridged in the new situation in Bajhang district?

**Please rate your technology skills.**

Please rate <b>your</b> technology skills:	<b>Poor</b>	<b>Fair</b>	<b>Excellent</b>
Keyboarding/typing Using a smartphone Using a tablet/iPad Using the Internet			
Creating videos Making video calls Taking pictures			
Using YouTube			
Using social media			
Sending/receiving emails			

## Appendix 2

**Questionnaire for interview to the mathematics teacher for completing the research entitled “digital divide and online learning in mathematics education”.**

Name:

Post:

Name of School:

Location of School:

Location of Home:

I heartily request to the student, please give the answer.

**2. What devices do you have at home? Circle the devices that are available to you.**

- |                         |                   |             |     |
|-------------------------|-------------------|-------------|-----|
| i) Smartphone<br>Laptop | ii) Tablet        | iii) iPad   | iv) |
| v) Desktop computer     | vi) Gaming system | vii) Others |     |

**2. Do you have Computer/ Laptop at home?** Yes/ No

**3) Do you have internet at home/school?** Yes/ No

**4) Have you use ICT Tools in Classroom?** Yes/ No

**5) How do you use the internet? Circle the ways in which you use the Internet.**

- |  |                                       |                               |
|--|---------------------------------------|-------------------------------|
| i) send/receive emails                                 | ii) Find information                  | iii) Teach online classes     |
| iv) Watch YouTube materials                            | v) Communicate with others            | vi) Search teaching materials |
| vii) Download the videos related to teaching tutorials | viii) Look teaching                   |                               |
| ix) Upload videos and audios in YouTube internet       | x) Connect the curriculum to internet |                               |

**6) Have you taught online classes in mathematics?**  
Yes/ No

**7) Have you taught digital class in your school?**  
Yes/ No

**8) Do you have enough digital literacy?**  
Yes/ No

9) Do you know about Mathematical specialists software such as Computer Algebra System (CAS), Dynamic Geometry System (DGS), Matrix Laboratory (Mat Lab), Statistical Package for the Social Sciences (SPSS) ? .....

10) Can you use Mathematical specialists software such as Computer Algebra System (CAS), Dynamic Geometry System (DGS), Matrix Laboratory (Mat Lab), Statistical Package for the Social Sciences (SPSS) ? .....

- 11) Can you teach mathematics digitally in classroom? .....
- 12) What is the existing situation of digital divide in your area of school and home?  
.....
- 13) What are challenges and opportunities of online learning in mathematics education in Bajhang district ? .....
- 14) How the situation of digital divide can be bridged in the new situation in Bajhang district? .....
- 15) How did you feel about online classes in Corona Pandemic time?  
.....

### Appendix 3

**Questionnaire for interview to the education officer for completing the research entitled “digital divide and online learning in mathematics education”.**

Name:

Post:

Name of Rural Municipality:

Location of Rural Municipality:

I heartily request to the student, please give the answer.

1. From when have you started in your post? .....
2. How many years have you spent in education administration field?  
.....
3. How many schools up to class 12 are there in your municipality? Categorize them.  
.....
- 4.) How many students are there up to class 12 in your municipality? Categorize them government or private. ....
- 5) How many schools of your Rural Municipality do have computers/Laptops?  
.....
- 6) How many schools of your Rural Municipality do have projectors? .....
- 7) How many schools of your Rural Municipality do have Digital White Board?  
.....
- 8) How many schools of your Rural Municipality do have internet access? .....
- 9) What is the condition of internet access of your schools of your Rural Municipality? ....
- 10) What is the condition of digital class in your schools of your Rural Municipality?  
....
- 11) How many schools of your Rural Municipality do have electricity? .....
- 12) How many schools of your Rural Municipality do have Telephone? .....
- 13) How many schools of your Rural Municipality do have in the range of Radio? ....
- 14) How many schools of your Rural Municipality do have in the range of TV? .....
- 15) How many schools of your Rural Municipality do have online class? .....
- 16) What is the situation of classes in corona Pandemic time? .....
- 17) How the schools of your Rural Municipality afford internet access? .....
- 18) Have you given Laptops/computers to teachers for the help of online teaching in your Rural Municipality? .....

- 19) Have you given Laptops/computers to students for the help of online class in your Rural Municipality? .....
- 20) Have you given any fund to the school for digital technology regularly?  
.....
- 21) Have you given any fund to the school to get internet access? .....
- 22) What is the condition of internet access in your Rural Municipality? .....
- 23) What is the condition of afford capacity of your teachers of Rural Municipality for online learning? .....
- 24) What is the condition of afford capacity of your students of Rural Municipality for online learning? .....
- 25) How many schools of your Rural Municipality do run online classes?  
.....
- 26) How many schools of your Rural Municipality do run online classes in Corona Pandemic time? .....
- 27) What is the existing situation of digital divide in your Rural Municipality?  
.....
- 28) What are challenges and opportunities of online learning in mathematics education in your Rural Municipality? .....
- 29) How the situation of digital divide can be bridged in the new situation in your Rural Municipality? .....
- 30) How did you feel about online classes in Corona Pandemic time? .....