

**OPPORTUNITIES AND CHALLENGES OF DIGITAL TECHNOLOGY IN
TEACHING-LEARNING MATHEMATICS**

**A
THESIS
BY
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DEGREE OF MASTER IN EDUCATION**

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This is to certify that **Mrs. Ganga Acharya** student of academic year 2074/2075 with campus roll no 196, Exam Roll No. 7428265, ThesisNo. 1723and T.U. registration no. 9-2-726-2013, has completed her thesis under supervision of Prof. Dr. Bed Raj Acharya during the period prescribed by the rules and regulation of Tribhuvan University, Nepal. The Thesis entitled "**Opportunities and Challenges of Digital Technology in Teaching-Learning Mathematics**" has been prepared based on the result of her investigation conducted From 2021 to 2022 under the department of Mathematics Education, Tribhuvan University, Kirtipur Kathmandu. I hereby recommend and forward that his thesis be submitted for the evaluation to award the Degree of Master of Mathematics Education.

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Letter of Approval

This thesis entitled "**Opportunities and Challenges of Digital Technology in Teaching-Learning Mathematics**" submitted by **Mrs. Ganga Acharya** in partial fulfillment of the requirement for the Master's Degree in Education has been approved.

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Recommendation for Acceptance

This is to certify that Mrs.GangaAcharya has prepared this thesis entitled
**"Opportunities and Challenges of Digital technology in Teaching-Learning
Mathematics"** under my guidance and supervision. I recommend this thesis for
acceptance.

Date: February 11, 2022

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Declaration

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

Date:February 11, 2022

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Ganga Acharya

Dedication

Dedicated to

To my respected parents and teacher and my friends who support me in every
situation of life

Acknowledgement

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.....

Ganga Acharya

Abstract

This is the research on "opportunities and challenges of digital technology in mathematics education" main objectives were to explore the existing practices of digital technology in teaching and learning mathematics, to find out opportunities and challenges of the teacher using digital technology in teaching mathematics, and to explore opportunities and challenges of the students using digital technology in mathematics learning. Thus this study is based on the ethnography research design on the theoretical basis of the Connectivism theory.

For this study, one school of Kathmandu valley, Sitapaila Secondary School was selected. The data were collected through the interview guidelines, observation guidelines, and focus group discussion. To meet the purpose of study one mathematics teacher for interview and class ten students for focus group discussion were selected. The data were analyzed and interpreted by different themes based on the conceptual framework and generated the different codes according to the response of participants and the triangulation method, member checking, and field observations.

The study concludes that the use of technology in mathematics learning is increasing day by day and mostly mathematics teachers and students are using digital technology in mathematics teaching and learning. Also, digital technology provides a great opportunity for schools and universities in developing and improving their teaching and learning processes. Technology provides additional opportunities for learners to see and interact with mathematical concepts. Digital technology in teaching and learning mathematics was rarely used before lockdowns. After the pandemic situation of coronavirus, the school and universities were unable to run physical classes for a long time then started using digital technology in the teaching-

learning sector highly. Mathematics teacher of Sitapaila Secondary School, Nagaarjun-4 using the laptop with projectors in the classroom to teach geometry and algebra. Most of the students are used YouTube and google.

For the conceptual development of mathematics, one of the abstract subjects, the learning is being more effective by the use of digital technology in teaching-learning mathematics there are many opportunities and challenges faced by teachers and students.

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Chapter I

INTRODUCTION

Background of the Study

In the current time, technology plays a vital role in teaching and learning. In this rapidly changing environment, education should change as quickly as technology does. Technology integration was helpful, meaningful, and necessary for human life. Traditionally the way of communication was through Sharing their information, idea, skill, and the use of paper-based approach but now the way of communication has been totally changed because of the development of digital technology such as computer, mobile, projector and social media such as email, internet, Google, YouTube, etc., which are particularly used on every stage human life. Digital technology has used the purpose of saving time and for the good productivity by every person such as teacher, student, businessman, farmer, officer, etc.

Today mathematicians use computer, digital tools not only for calculations but also for numerous other tasks, including the search for proofs, validation, and counterexamples. Technology provides additional opportunities for learners to see and interact with mathematics concepts. Students can explore and make discoveries with games and digital tools. Digital technology and social media for effective and interacting learning must be used for self-learning, sharing-based learning collaborative learning, web-based learning, and virtual learning for teaching and learning mathematics (Awasthi, 2020).

Technology can enhance the relationship between teachers and students when teachers effectively integrate digital technology into the subject matter it makes teaching and learning effectively. Digital technology is a very powerful tool for education. Also, it helps to contact outside experts and audience beyond the teachers

meaningful contact between teachers and students Working on the same activity out of school, ways for students to view and build on the work of others in their group or classes across time frames and distance means to enhance the participation Of all students. It gives the facility for timely feedback from teachers and peers (Seechailo, 2014).

Nepal is a developing country that is still behind in employing technology for teaching and learning mathematics. The government emphasizes integrating technology in teaching and learning mathematics. Recently school sector development plan of Nepal introduced ICT in the school sector by stabling computer labs and internet connectivity, projectors, Smartboard and Television with internet connectivity in schools. Furthermore, central level agencies regional education directorates, and all district's education offices have launched websites and have launched websites and have developed digital learning materials for students in grades 2-6 in Nepali, Mathematics, English, and Science (SSDP, 2016-2022). Thus, the government of Nepal is practicing different programs to use technology in education. On teacher and students both facing the opportunity and challenges of using digital technology while teaching and learning procedures.

According to Fluck (2010), the future of information, communication, and technology should play a transformative role in education rather than integration into existing subject areas. The transformative view of ICT in education requires us to examine what new ways of pedagogies and curriculum are appropriate for a new generation working with new tools. Mathematics is one of the most important subjects for students to learn in schools. Mathematics starts to become more abstract for students in middle schools. But now technology has waved the path in front of students for better understanding by the opportunity of digital technology.

Digital technology allowed teachers and students to improve engagement, knowledge, encourage individual learning, encourage collaboration, and it also helps the teacher with content delivery. It gave resources new opportunities for learning and way to communicate to teachers and students. Also, it helps to connect with outside experts, meaningful contact between teacher and students working on the same activity out of school, ways for students to view and build on the work of others groups or classes, purposeful interaction between students and different schools level or classes across time frames and distance means to enhance the participation of all students (Seechailo, 2014). It gives opportunities and challenges to both teachers and students.

ICT plays a strenuous role to make teaching and learning activities more meaningful (MOE, 2013). Therefore, this is the curiosity why many students like digital technology in mathematics education. Does it enhance the quality of mathematics education? What are the opportunities and challenges to the students and teacher both to use digital technology in learning mathematics, teaching-learning activities of technologies uses class, Application of ICT tools, ICT lab, Internet facilities?

These profiles mentioned above help to measure the use of digital technology in the mathematics classroom: Opportunities and Challenges in the context of Nepal.

Statement of Problem

The statement of the problem is the description of an issue currently existing which needs to be addressed. It provides the context addressed. It provides the context of the research study and generates the questions that the research aims to answer. So, the statement of the focal point of any research.

The 21st century requires new concepts and skills to be required by learners at various levels. This study has generated a lot of interest in how the process of knowledge acquisition is changing through digital technology. There is excited attention among researchers, educators, education commentators, and stakeholders on this aspect of digital technology learning. The old pedagogy, materials, methods, the teacher is the absolute source of being transformed by the use of an array of emerging devices like smartphones, laptops, computers and others readily available to the learners to invest in internet connectivity, ICT infrastructure, capacity building among others structure that can be leveraged for Education needs in teaching and learning. Providing access to quality education and expanding learning opportunities for the mathematics student.

The use of digital technology in Nepalese school and colleges are very limited because of many factors including lack of availability of resources, lack of poor infrastructure, large class sizes, improper training for stakeholders, lack of manpower, and lack of teacher knowledge and skills to integrate ICT. (Budha,2021). Students can develop a deeper understanding of mathematics with the appropriate use of technology. Technology can help to support an investigation by reflection, reasoning, and problem-solving. The existence, versatility, and power of technology make it possible and necessary to what mathematics students should learn as well as how they can best learn it (NCTM, 2000).

Objectivesof Study

The main objectives of this study are to find the opportunity and challenges of digital technology teaching-learning at the school level.

More precisely the objectives of this study were:

1. To explore the existing practices of digital technology in teaching-learning of mathematics.
2. To find out opportunities and challenges of the teacher using digital technology in mathematics teaching.
3. To explore the opportunity and challenges of the students using digital technology in mathematics learning.

Research Questions

1. What are the existing practices of mathematics education by using digital technology at the secondary level?
2. How do teachers get the opportunities and face challenges of using digital technology in mathematics?
3. How do students get the opportunities and face challenges of using digital technology in mathematics learning?

Justification of Study

The justification of the study is a part of the introduction of the research. It should determine who benefits from the study and how that specific audience would benefit from its benefit and findings.

Here, the findings of my study would be useful to scholars in the area of mathematics education as they added to the field of knowledge. It would be beneficial to the mathematical students and teachers of the school level by giving them insight into how Digital technology can improve their teaching method.

One of the challenges to mathematics teachers is to make apposite feeling in students toward learning mathematics. Therefore, teachers should be aware of the importance and effectiveness of digital technology in mathematics education. The results of this research will help to motivate students towards mathematics with the

interaction of digital technology and it helps teachers to familiar with digital technology and it helps the teacher to familiar with digital technology and make easy to provide the mathematical content.

In Short, the significance of the study is as follows;

-) The study provides the effectiveness of digital technology and it would help policymakers and planners.
-) It would help to familiarize with the opportunities and challenges of using digital technology in teaching-learning mathematics education.
-) This study would help to give suggestions for the improvement in the solution of challenges.
-) The study provides the perception of teachers and students toward digital technology in mathematics education.
-) The results and findings of the study contribute to the body of research in using digital technology in mathematics education.

Delimitations of Study

Delimitation is the boundaries of the study. There is the restriction intentionally placed by the researcher.

This study was delimited under the following ways:

-) This study was limited to Kathmandu valley
-) This study was limited to opportunities and challenges faced by teachers and students using digital technology
-) This study is based on qualitative research.
-) This study is limited to school-level teachers and students.
-) This research was limited to Sitapaila Secondary school teachers and students.

Limitations of Study

The main objective of the study explored existing practices of digital technology and opportunities and challenges faced by students and teachers using digital technology in teaching-learning mathematics. I planned to observe the ten classes but I only observed four classes then the school exam was started on 3rd January 2022.

After the exam school's winter vacation was started during the winter exam Nepal government announced to close the school because of the pandemic situation of the omicron variant till 29th January 2022.

Operational Definition of Key Terms

Key terms of this study were defined as below:

Challenge. That educators, education administrators, and other stakeholders need to be considered include educational policy and planning, infrastructure, language and content, capacity building, and financing of Sitapaila Secondary School.

Digital technology. Digital technologies are electronic tools, systems, applications, software, recourses that generate, store, or process data. Like social media, online games, projectors, multimedia, mobile phones, and laptops. Digital learning is any type of learning that uses technology. It can happen across all curriculum learning areas.

Information communication technology (ICT). The use of any equipment or software for processing or transmitting digital information that performs diverse general functions whose options can be specified or programmed by its user.

Mathematics education. Mathematics education is the practice of teaching and learning mathematics, along with scholarly research. Mathematics education is referred to as the practice of teaching and learning mathematics in a way of solving

problems involving learning algorithms and formulas necessary for computations. It is a platform to learn and teach mathematics in a better way.

Opportunity. Educators have a momentous opportunity to reinvent themselves as resources for the entire in collaborating, which students access of digital technology use in mathematics included portables, graphic calculators and computerized graphing, Specialized software, applications like Geogebra, Mathematica, Mathlab, Microsoft mathematics, spreadsheets, and databases, infrastructure and internet connectivity.

Students. Those students who are studying and interested in mathematics learning.

Teachers. Those teachers who are teaching mathematics subjects.

Chapter II

LITERATURE REVIEW

Review of the related literature is an essential component of research which begins from the beginning to the end of the research. Literature review gives support and guideline for the researcher to meet the objectives of the research. It has got a specific purpose to identify how the research problem is new and to know the gap of whether the works have been done or have not been done in forthcoming research (Creswell, 2012).

Thematic Literature Review

In the world of information technology, rapid changes have taken place in education. Intense competition and efforts toward the formation of a world-class education system have also emerged. Here I reviewed the literature and organized them in thematic ways so, for thematic literature review, Some national and international thesis, articles, and journals were read and made some themes that are related directly and indirectly to my research topic. Thus the themes are:

-) Digital technology.
-) Digital technology in teaching-learning mathematics.
-) Digital technology policy and programs in school education.
-) Opportunity and Challenges faced by mathematics teachers using digital technology.
-) Opportunity and Challenges faced by mathematics students using digital technology.

Digital technology. Nayak,(2018) claimed that technology provides a new way of learning and it helps to learn mathematics better. That means Technology can reduce the effort devoted to tedious computations and increase students' focus on

more important, mathematics. Equally importantly, technology can represent mathematics in ways that help students to understand concepts.

Digital technology is used to purpose saving time and for good productivity by every person such as teacher, student, businessman, farmer, officers, etc. (Allbalawi, 2017).

According to UNESCO " ICT is scientific, technological, engineering disciplines and management technique used in handling information, its application and association with social, economic and cultural matters".

Similarly, digital technologies reflect the general trends and major evolutions of the field but it is also the source of inspiration for these. Over the last decades, the developments of microworlds and education involving them have thus been supported by the constructivist approach but it has also contributed by their progressive evolution (Papert, 1980).

There has been an increase in the use of multimedia technology, especially computers and special software, in the teaching of science and mathematics. There are various types of technologies currently used in traditional classrooms. Among these are Radio, television, audiotape, videotape, slide projectors, overhead projectors are passive learning when the interaction is less. The applications used in mathematics are photomath, GeoGebra, Mathematica, and others. Teachers and students can interact not only in class in various ways like Zoom, Microsoft Teams.

Digital technology teaching-learning mathematics. The use of digital technologies increases day by day due to pandemic situation School and colleges are mostly using technologies, social networking. (Joshi, 2009) found that the use of ICT in mathematics teaching has a role to increase students' achievement, development of knowledge, skills, attainment, and mathematical understanding. The use of ICT by

mathematics teachers in school and opinions of mathematics teachers towards the use of ICT has been measured in this study. 342 mathematics teachers of secondary schools were taken by multistage cluster purposive sampling techniques in this survey and data was analyzed by percentage, mean standard deviation, and Mann Whitney U test. The researcher found that mathematics teachers of secondary schools of Nepal are using ICT for documentation purposes and less use it in teaching and learning. It also indicates that computers of school have been used for official tasks and computer subject teaching because all school has taken based on the availability of computer facility from developed areas of the country. The researcher found that Private school teachers were using ICT in school more than their public counterparts even male and female teachers were not significant. The researcher also found that ICT has several additional roles in the field of education even mathematics teachers not highly using ICT in several tasks hence all stakeholders should be investigating the cause and must find essential solutions.

In the basic principles and standards of school mathematics, The National Council of Teachers of Mathematics (NCTM) identified the "Technology Principle" of high-quality mathematics education (NCTM, 2000). This principle states "Technology is essential in teaching-learning mathematics; it influences what is taught and enhances student learning ", but it is fact that mathematics teaching and learning in Nepalese schools often focused on memorization of facts and formulae. The teaching and learning of mathematics are that there should be a move from emphasizing memorization of facts by learners to a more learner-centered approach where learners enhance their questioning, elaboration, explanation, and other verbalization mechanisms, which contribute to the development of problem-solving and higher-order thinking skills in mathematics.

There has been an increase in the use of multimedia technology, especially computers and special software, in the teaching of science and mathematics. There are various types of technologies currently used in classrooms. Among these are: Radio, Television, Audio Tape, slide projector, overhead projector are of passive learning when the interaction of the learner is less.

Drijves, Boon & Reewijk (2010), distinguished three main didactical functionalities for ICT in the teaching and learning of mathematics:

-) The tool function for doing mathematics, Which refers to outsourcing work that could also be done by hand,
-) The function of the learning environment for practicing skills,
-) The function of the learning environment for fostering the development of conceptual understanding.

In a Similarly way, (Rahman, Ghazali & Ismail, 2003) describe the main purpose of using ICT in mathematics teaching and learning as to develop the ability to solve a wide variety of complex mathematics problems. The process of problem-solving involves understanding the problems, devising a plan or solution based on deductive and inductive analysis and mathematical models, implementing the plan, and looking back. The skills required for these processes include communicating and expressing ideas through symbols, tables, diagrams, and other mathematical illustrations; mathematical characters, curiosity, motivation, and interest in learning mathematics; resilience and confidence in using mathematics to solve its related problems.

Pannen,(2013) also claimed The integration of ICT in teaching and learning mathematics can be seen at two levels: ICT for learning mathematics, and a new strategy for teaching mathematics with ICT. When a teacher uses ICT for learning

mathematics, s/he can still design the teaching in an old fashion way of face-to-face classical teaching, Thus ICT is a more technological tool that can assist students to learn, to do drills and practices, to do exercises on certain concepts in mathematics.

Dahal&Dahal,(2015) has made a conclusion based on their research about Opportunities and challenges to use ICT in Nepalese mathematics Education where ICTs provide great opportunities for school/universities in developing countries to improve their teaching and learning processes. So, Far most of the schools/ universities in developing countries possess basic ICT infrastructure such as internet, computers, video, audio, and mobile technology facilitate that form the basis for the establishment of E-learning. It argued that schools universities in developing countries should adopt e-learning technologies to improve teaching and learning processes. They conclude that describes opportunities, effectiveness, efficiency, motivation, simplify abstract knowledge, instructional resources, improve students performance and achievement and quality, pace & accreditation of learning.

Also, they describe challenges like geographical diversity, infrastructures, awareness & attitude, economic readiness, and trained facilitator. The implementing the ICT familiar Curriculum Development Centre and other related sectors need to think about removing the challenges that we are facing. I think at first the Ministry of Education needs to develop and implement the ICT familiar curriculum in each education level.

Shrestha, (2015) described on Status of ICT use in teaching/ learning mathematics to find out the use of ICT in mathematics teaching-learning in heartland's children's academy. Her research design was qualitative with the case study.

The data has been collected from the primary source. Also, class7, 8, 9,10, and interview 4 teachers at heartland's children's academy school in Kathmandu. She has found from the study that there was neither any plan on the use of educational technology tools in mathematics teaching and learning nor inadequate teachers training on the use of educational technologies. In addition, there was a lack of relevant educational technology tools in mathematics teaching and learning.

Moreover, Amuke, Miheso&Ndeuthi (2015) researched the topics Opportunities and Challenges: Integration of ICT in teaching and learning Mathematics in secondary schools, Nairobi, Kenya. The objective of the study was to examine the challenge and opportunities to ICT use in Teaching and Learning Mathematics in secondary schools. The research design of the study was a descriptive survey. The sample was taken from 24 mathematics teachers in secondary school in Nairobi, Kenya. They were used purposive sampling, The data collection tools were questionnaires, observation from and interview guidelines. They are data was interpreted by Code Sheet (SPSS) and themes, mean frequency, and percentage. The study found that has not adequately trained on ICT integration in teaching and learning mathematics in secondary schools. The researcher concluded that teachers to be trained on how to use ICT infrastructure regularly and training to be done at the zonal level at least after every six months.

Digital technology policy and programs in school education.ICT-MP-2013 MOE has implemented some programs related to education. They are one laptop per child (OLOC) pilot project in selected 26 schools of six districts project in school and some internet connectivity to district offices computers labs with an internet connection from local ISPS. Central Regional Five Directorates (REDS) and 77 district Education offices have launched their websites.

DOE with involvement of learning materials for the student's grades 2-6 in Nepali, Mathematics, English, Science subjects. It helps teachers and students with digital literacy. They know how to conduct class with the bits of help of ICT materials and clarify content and subject matters as well as they can use online materials using the help of the internet.

DOE provided 2 computers and one printer to 3038 schools (DOE, 2010), DOE provided internet connectivity to 85 schools conducting distance education programs (DOE, 2012) during 67/68 government of Nepal has to support ICT related infrastructure and internet connectivity to 785 schools. Four components of ICT in education Master plan development of infrastructure including connectivity (internet), Development of human resources, development of digital learning materials, and enhancement of Education system. Similarly, SSRP (2009-2015) has made policy and provision modes of development ICT infrastructure in education with internet and provide alternative modes of school through the use of ICT and making class e-library and one of the objectives is open distance learning. The three years plan (2011-2013) of GON has included policies related o ICT in education to increase access to equality education in rural areas, the digital divide will be reduced and ICT will be integrated with all aspects of education. In 2020 distance education is one of the best ways to promote class due to Covid-19 and affected by natural disasters with the help of the internet through the online class helping apps are Zoom, Microsoft Teams, and other different kinds of apps while teachers and students are not able to meet physically but they can meet and solve their problems by virtually. The vision of the Master Plan is to ensure extensive use of ICT in the education sector and contribute to access to and quality of education for all. The mission of the Master Plan is to narrow down the digital divide through the development of ICT infrastructures, human resources,

digital content, and system enhancement in education. The main goals of ICT in Education are: to expand equitable access to education; enhance the quality of education; reduce the digital divide, to improve the service delivery system in education.

ICT National Policy 2015 has considered A nationwide E-school and other related initiatives will be formulated and launched to promote E-learning and E-education, as well as lifelong education institutions, will also be enhanced in a way that helps improve board learning outcomes. To fulfill this policy Ministry of Education provides the internet to all secondary schools. Many other NGOs also help the schools to get internet facilities.

The main goal of ICT national policy 75% digital literacy skills by the end of 2020 entire population of Nepal could be offered online by 2020 to get this goal ICT human resource plans will be developed and implemented in close coordination with industry and academia, fracturing, in technological dynamism shaping the ICT sector in similar way excellence for training or education in telecommunication and electronic engineering, computer science information communication technology and all related fields. E-learning systems will be promoted to extend the reach of educational services including teacher training programs. Nepal Telecom also helps the teaching-learning process to promote the class and other facilities by providing a CUG sim.

Likewise, National Curriculum Framework (2007) has accepted that ICT has been proved as one of the important tools for promoting education throughout the world. If the new area of learning is not included in the curriculum, the youth will be deprived of today's global education reality, so its need to develop ICT as the subject matter and medium both in the curriculum to education change. This policy also used

the internet as the tool of communicating and transforming information related to the school administration.

In the same way, School Sector Development Plan (2016-2023) has set the goal to improve teaching and learning, increase access to teaching materials through the development of the skill of ICT with students. Ministry of Education has started establishing computer labs in some of the schools, websites in all district education office, regional and central bodies of education in the country. It gives the proper attention to constructing ICT friendly environment to improve teaching-learning. It has also the objective to develop the teaching materials and to increase the skills of using ICT in educational administration and management. This policy also focuses on providing citizens with the knowledge and skills they need to work for the development of the country and to integrate Nepal into the global community. To achieve this goal, the Government of Nepal is working to ensure access to quality basic education for all and to develop work and job market-relevant education. With the expanding role of information and communication technology (ICT) in all areas of life, MOE considers the use of knowledge of ICT essential.

Teachers are using the internet as a tool in teaching and learning tool in class. ICT is the main tool in teaching, teachers are using it nowadays because we are in the digital age and students get to learn livelily. It increases the students learning achievement if there is available ICT tool related to the ICT such as infrastructure, internet, human resource, and so on. Using ICT in school is challenging to make an appropriate environment, infrastructure and used ICT as a tool for teaching and learning. So the government needs to address these problems, should motivate the private sector of internet provider to cooperate with school, and then it becomes

fruitful all school level education student can better-learning achievement, effective and long-lasting.

Opportunity and Challenges faced by mathematics teachers using digital technology. Teachers need specific professional development opportunities in their ability to use digital technology for formative learning assessment, individualized instruction, accessing, online resources, and collaboration.

Timilsena(2017), analyzed the attitude of teachers toward ICT in teaching Mathematics and carried out to find the existing situation and attitude of teachers towards ICT about improving student's Mathematics achievement and analyzed/explain the effect of ICT in motivating students to learn Mathematics. The result of the study showed that the schools have sufficient ICT tools with suitable existing suitable for teaching and learning.

Ghimire (2017), research-based on problems faced by Mathematics teachers in teaching Mathematics at Secondary Level and The purpose of this study was to identify the problem faced by teachers due to school administration, teaching materials, classroom management, mathematical concept, and student background characteristics and to suggest some measures for the solution of the problem. This study was descriptive and authenticated by qualitative data. The questionnaire, interview guidelines, and class observation were the main tool of the study. Open questionnaires were included in each category of problems, and descriptive analyses of collected responses were carried out. Mean weightage was used for the analysis of the problem.

Oldknow and Knights(2011), analyzed ICT practice in schools in United States technology in a variety of forms is becoming increasingly common in classrooms in the united states, as it is in much of the rest of the world. In fall 2005,

nearly 100% of public schools in the United States had access to the internet, compared with 35% in 1994 and 94% of public school instructional rooms had internet access, with little difference by school characteristics (Wells and Lewis, 2006). Interactive whiteboards are becoming more and more prevalent in schools in 2007, 21% of the classrooms were equipped with them, 35% in 2009, and prediction is that by 2011 nearly 50% of US classrooms will have interactive whiteboards (ICT products Market Report, 2008). Another type of technology, classroom response systems or 'clickers', was used in 16% of the classroom (Texas Instruments Education Technology, 2009). Online courses are becoming more common, particularly for students in small schools primarily as a way of reaching underserved students, not as a preferable alternative to classroom instruction. Teachers are facilitating persons or guideliners.

Mulenga (2020) presented a dissertation *Is COVID-2019 the Gateway for Digital Learning in Mathematics Education?* Digital Learning has reshaped education in many ways. The purpose of this study is to respond to the question of whether COVID-19 is the gateway for digital learning in mathematics education. To this end, this study explores some uptakes of social media platforms by prospective mathematics teachers from the Copperbelt University (CBU). A cluster analysis approach was used. Results revealed that participants' scores for digital learning in mathematics in cluster 2 were higher than those in clusters 1 & 3. This is a clear indication that prospective teachers in clusters with low scores are more likely to exhibit low skill levels in the use of mobile technology and the adoption of social media about mathematics pedagogy during the COVID-19 crisis. Results response to COVID-19 Closure period.

Opportunity and challenges faced by mathematics students using digital technology. With the emergence of the internet and new technologies, eLearning has become the promising solution for the school level which is currently an environment of instant change.

The national center for Education Statistics shows a growing demand and acceptance of online learning (Waits & Lewis, 2003) while students who have been involved in eLearning courses are generally very positive about their experiences.

In the UK (Green & Hannon, 2007) in general, confirm that the vast majority of the students have ready access to web-enabled personal computers and web features and own personal digital devices such as mobile phones. They also use a wide range of digital features and web features in their everyday lives, for communication like email, Zoom, Microsoft Teams, etc, or forming social networks (blogging, Facebook, Whatsapp).

The 6th International Conference Edu World " Education facing Contemporary World Issues" On the issue of students perception regarding the use of technologies related more precisely to their perceived experience and expertise in the subject. We thought this question to be important because the premise is that students' perceptions towards using technologies might influence their perception of using technology in educational contexts. The researcher found that as anticipated the experiences students had using technology in their daily lives are quite impressive. Concerning their everyday use, There was ownership to digital devices as well as applications and services. Almost all students 98% consider that they have medium and advanced expertise in using computers and laptops, while 96% same level of expertise and internet usage. 50% of students all categories of hard components (pad, Smartphones) declared medium-advanced level of competencies.

For instance, the individualized character of the eLearning was the first option when indicating that e-Learning was the first opinion when indicating that e-Learning strategies and digital technologies are mostly employed within the individual activity of the student (Mironov, C. & Borzea, A., 2013).

This study investigated students' views on eLearning technology in non-formal settings. Although the number of responses was not high 115 valid replies. It becomes quite obvious that students are deeply aware of the changes are brought over by digital technologies, by their impact on the learning process. Also, it is clear that students are well equipped in using technology informal environments and are already using these technologies to support their learning process.

Theoretical Literature

The theoretical framework of the study was the structure that can help or support a theory of research work. It helps the researcher to define and see the variable of the study (Khanal, 2074).

The research is connected with the Connectivism as a Digital Age learning Theory because digital technology and social media generate the knowledge as connectives approach so that the digital technology and social media for the teacher and student in teaching and learning mathematics, which has generated the main approach of digital technology and social media in the field of education and learning process (Downes&Siemans, 2009).

Connectivism

Connectivism is still a moderately new learning theory and without criticism(Gracia, E, Brown, M. &Elbetagi, I, 2013). Connectivism theory is defined by Siemens (2005) as a learning theory for the digital age. Connectivism learning theory was established from the belief that there is a need for a learning theory, which

takes due cognizance of how societies have changed because of the new technologies or technological advancement (Gracia, E., Brown, M., & Elbetagi, I., 2013). The theory has been developed to provide a model through which teaching and learning, The use of ICT such as digital technologies can be better understood and managed (Siemens, 2005).

Siemens (2005) outlines eight principles of Connectivism

-) Learning and knowledge rest in a diversity of opinions.
-) Learning is a process of connecting specialized nodes or information sources.
-) Learning may reside in the nonhuman appliance.
-) The capacity to know is more critical than is currently known.
-) The ability to see connections fields, ideas, and concepts is a core skill.
-) Currency (accurate, up-to-date knowledge) is the intent of all connectivist learning activities.
-) Decision-making is in itself a learning process.

Connectivism is the integration of principles explored by chaos, network, complexity, and self-organization theories. Learning is a process that occurs within a nebulous environment of shifting core elements- not entirely under the control of the individual. Learning can reside outside of ourselves is focused on connecting specialized information sets and the connections that enable us to learn more than is more important than our current state of knowing.

Connectivism is characterized as a reflection of our society that changes rapidly. Society is more complex, connected socially, global, and mediated by increasing advantages in technology. Rather than a new learning theory, connectivism offers educators a model or mental representation that depicts something that cannot be observed or experienced directly (Dorin, H., Demmin, P.E., & Gabel, D., 1990).

While the debate over the status of George Siemens and Stephen Downe's theory of connectivism will continue to be debated for many years, it is undoubtedly important of thought directly applicable to the use of technology in the classroom today. There is no doubt that online learning cultures, methods, and inspirations. The combination of 3D interactive graphics and web technologies (Web 3D) will permit instructors to create an interactive, realistic environment for the student in an online environment (Chittoro, L., & Ramon, R., 2007).

Comparing learning when using modern information communication technologies with traditional learning.

Traditional Learning	Connective Learning
Memorizing facts, dates, details	Connecting to information sources
Understanding process and phenomenon	Gathering knowledge in devices
Teaching Concepts	Searching knowledge
Practicing Skills	Creating and maintaining connections
Solving different subject problems, both theoretical and practical ones	Perceiving relationship between areas ideas and concepts
Gaining personal experience	Critical thinking
Solving tests	Selecting the content of learning and making decision independently

Source:(Jolanta Szada-Borzyszkowska, El bieta Jaszczyszyn, 2014)

Technology influences all theoretical viewpoints by providing techniques and unique instructional methods. Every new idea and theory presented merits close examination for the possibility of helping students learn more successfully. Connectivism offers that diversity through a variety of networks, helping the new generations collaborate to find solutions to an ever-increasing number of questions.

There is always a certain amount of core knowledge that is required to be able to understand any information presented (Awasthi, 2020).

The connective theory in the field of mathematics has the following aspects:

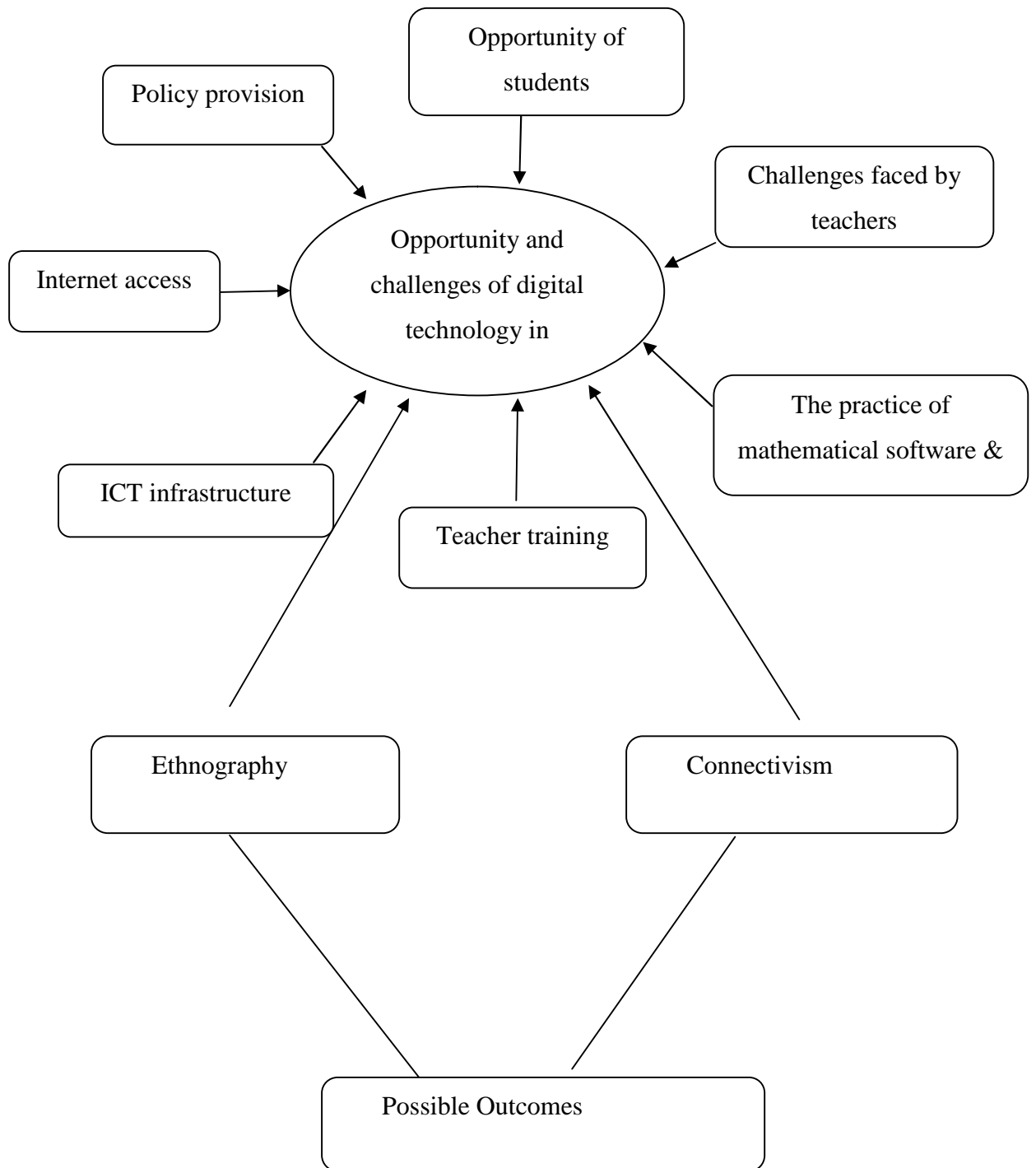
-) Aspects of connectivism resonate with techniques and approaches known from professional practice to be broadly successful in alleviating mathematics anxiety achieving mathematics anxiety and achieving effective learning outcomes.
-) The pursuit of opportunities to approach learning mathematics as a language and to form multiple links to connect new information with students existing knowledge networks.
-) The ability to see connections between fields, ideas, and concepts was a core skill.
-) Connectivism connects with mathematics language to natural language and the converse.
-) The capacity to know is more critical than what was to know.

As such, Connectivism involves opportunities for peer-to-peer learning networks where learning occurs in short bursts driven by the needs and interests of the learners and where flexible learning activities encourage interaction between instructors and students and among learners (Mallon, 2013). Connectivism presents itself as a pedagogical approach that affords learners. The ability to connect via social networking or collaboration tools. Learning was most appropriate to their learner (Siemens, 2003).

Conceptual Framework for the Study

A conceptual framework provides information about the structure/content of the whole study based on the literature review. The conceptual framework stems from

the theoretical framework and concentrates on one section of the theoretical framework which becomes the basis of the study. The conceptual framework was the plan of the specific frame on which the whole study is established in the diagram. It provided the general picture of the research. The following is the conceptual framework of my study:



Chapter III

METHODS AND PROCEDURES

Research methodology is a systematic and theoretical analysis of the methods applied in the field of study (Crotty, 1998). This chapter focused on research methodology. Especially, it describes; the research design, the respondents of the study, population sample, determination of validity and reliability of the instrument, pilot testing, data collection tools, data collection, data analysis procedure, and ethical considerations.

Research Design

The research design is intended to provide an appropriate framework for a study. A very significant decision in the research design process is the choice to be made regarding the research approach since it determines to show relevant information for a study will be obtained, however, the research process involves many interrelated decisions.

Research design describes a plan that describes how, when, and where data is collected and analyzed (Parahoo, 1997). Philliber et al, (1980) consider a research design as a blueprint for research, dealing, with at least four problems: research questions, which data is relevant, what data to collect, and how to analyze the results. It also includes how data is collected, what instruments are employed, how the instruments are used, and how the collected data is analyzed. A research design is "the researchers overall, for answering research questions or testing the research (Creswell, 2012).

This study will be based on Ethnography which is the type of qualitative research.

Ethnography

Ethnography is the study of people in the naturally occurring setting or field utilizing methods that capture their social meanings and ordinary activities involving the research participating directly in the setting (Brewer, 2005).

Ethnography involves observation of the group through the participation of the researcher. In this process, researchers involve themselves in the day-to-day life of the group and observe, interview the participants. Here, meaning behavior, the language, interaction of cultural sharing is focused.

Features of ethnographic research. It focuses on describing the culture of a group. Explain the social behaviors of an identifiable group. Researchers look for a pattern of group mental activities such as rituals, customary social behavior, etc. Extensive fieldwork, collecting primary data from interviews, observation, symbols, artifacts, and many diverse sources of data collection are used. The researcher presents the participant's view, reports the views in quotes, and synthesizes it from a scientific perspective and overall cultural interpretation with themes. The analysis results in an understanding of how the culture-sharing group works. (Acharya, 2074)

Area of Research

A research site is a place where people conduct research. Common research sites include universities, hospitals, research institutes, and field research locations. Since I used ethnography design in my research. The area of study will be based on school-level teachers and students of Sitapaila Secondary school of Kathmandu district.

The rural area may not have access to digital technology and in an also rural area, there are so many problems to using digital technology and also the challenges

and opportunities of digital technology. For this the facilities relating to digital technology. So I choose the Kathmandu districts school for my study.

Selection of Respondent

For the participant, I selected the mathematics teacher and students of Sitapaila Secondary school, Kathmandu using the purposive sampling technique. For the study of my research, I selected one teacher who teaches mathematics education and n students who has studied mathematics education from Sitapaila secondary School I had chosen for my research. Based on the conceptual framework.I used the purposive sampling technique for the selection of participants.

Data Collection Tools

To complete this research within time, research tools are necessary for particular work. Data collection tools depend on the research design. In this research ethnography research design was used and to collect the data following tools were used.

To fulfill the objective of this study interview and observation were the main tools for the data collection.

Observation.As a data, gathering device direct observation makes an important contribution to ethnography research. Participant observation is that in which the observation is familiar and participates with the object of the study. In this study, the researcher has used participant observation where the researcher was participating in the classroom. For my research, I have observed the student activity in the classroom some important data were collected.

The purpose of the classroom observation was to provide supplemental data for the study. In addition to generating interview questions and probes, Observations yield a detailed. I will observe ten classes of SitapailaSecondary School's class10.

Observation guidelines. Observation notes were used to identify the use and practices of digital technology in mathematics education, interactions of students-students and teacher-students about using technology in the classroom, and the effectiveness of the use of digital technology in classroom teaching and learning.

Interview guidelines. The interview is two-way communication between two or more persons. An interview is essentially a structured conversation where one participant asked questions and the other provides answers. Usually, the interview took place face to face and by phone also. This is also one of the major data collection tools which provide basic and personal information towards research. I developed different interview schedules for teacher and students. I took in-depth interviews with mathematics teacher using open-ended questions and unstructured questions to know the use of digital technology in the classroom what are the opportunity and challenges.

Focus group discussion guidelines. A Focus group refers to the process of discussion with a similar characteristics group in a particular issue. A focus group is a group discussion on a particular topic organized for research purposes. This discussion is guided, monitored, and recorded by a researcher. Therefore, a focus group concentrates to take profiling perceptions, experiences, and understandings of a group of people who share the same experience concerning a situation or event.

Focus group discussion with students of Sitapaila Secondary school.

Data Analysis Procedure

The information and data collected from various sources and means were analyzed meaningfully by the ethnography method. As well as the data produced based on interviews and focus group discussion by using the inductive method.

Interview and Focus group discussion are the main data collection tool.

The inductive approach, also known as inductive reasoning, starts with the observations, and theories are proposed towards the end of the research process as a result of observation.

Inductive analysis refers to approaches that primarily use detailed readings of raw data to derive concepts, themes, or a model through interpretations made from the raw data by an evaluator or researcher. Inductive reasoning is the act of making generalized conclusions based on specific scenarios.

The induction approach begins with a set of empirical observations and then theorizes about those patterns. Inductive analysis ethnography method of content analysis that researchers used to develop theory and identify themes by studying documents, recordings, and other printed and verbal materials.

Trustworthiness of the Study

In this study, for maintaining quality, I mainly maintained the credibility of my research through triangulation, member checking, field observation.

Triangulation. I triangulated and collected information to find common categories by illuminating unnecessary data. I will collect the data through multi-method such as interviews, observation, and focus group discussion. Triangulation is the combination of two or more methodological, theoretical, data source techniques. It enhanced confidence in research information exploring findings and provided explicit understanding.

Member checking. I used a collaborative and more ethical alternative to member checking. I interviewed with secondary math teacher of Sitapaila Secondary school, with help of interview guidelines open-ended and unstructured questions. And focus group discussion with students of class ten.

Field observation. I stayed ten days at the research site and worked with teachers. I made a trust with participants.

Ethical Consideration

Ethical consideration is the main thing to understand when we are in the field. Our ethical consideration helps to get true data from our respondents. Ethical rules in a study according to (Cresswell, 2014), contain two main areas as, research requirements and individual protection requirements.

I honestly report data, results, methods procedures, and analysis. Also, I did not falsify, or misrepresent data. The privacy of the participants was secured and respect for privacy. Data will take by consent without any harm. All the information was managed with strict confidentiality. I respected the autonomy of participants to answer the question.

Chapter IV

ANALYSIS AND INTERPRETATION

This chapter deals with sorting out establishing the connection of the different concepts and themes. The word "analysis" means breaking a whole into meaningful parts or components (Sharma, 2011). This chapter deals with the presentation and interpretation of the collecting data. In this study, data were collected from the observation guidelines, focus group discussion, and interview guidelines. The collected information from the informants has explored the existing practices of digital technology and found out opportunities and challenges faced by teacher and students using digital technology in teaching-learning mathematics. This chapter is divided into three sections. Section-I deals with the existing practice of digital technologies in teaching-learning. Section II and III deal with opportunities and challenges faced by teacher and students while using digital technology in mathematics teaching and learning.

Section I: Existing Practices of Digital Technology

This topic deals with my first research question. I observed four classes of the sampled school. This is ethnographic research so classroom observation is the most important part. The class observation was related to sampled schools and it started on 26 December to 29 December 2021. There were 21 students in the class, Among them 13 were girls and 8 were boys. The teacher entered as usual in the class he revised the previous lesson. This is the class of Geometry. The teacher used a laptop with a projector as a digital tool. He shows different types of shapes, sizes, and figures to prove the theorem. The teacher equally respondent curiosity of students. The involvement of students in teaching-learning activities was satisfactory. The use of digital tools was also satisfactory. Moderate interactions between student and student

and active interactions between teacher and students. The third and fourth observations of a class of that school. Most mathematical contents are related to abstract knowledge is algebra. The teacher shows formulas on projectors-related courses and content and he uses a whiteboard to solve other mathematical problems. In the classroom, the teacher use laptop, projector, and smartboard. Students have used social sites like Facebook, WhatsApp, YouTube, Nepal television classes. For collaborating and cooperating they mostly use the Zoom app when the physical class isn't available due to the COVID-19 lockdowns.

Moreover, some students have a laptop, a computer in their homes, all students use mobile phones some students use google and youtube channels to solve their mathematical problems and learn mathematics.

To conduct the focus group discussion I selected the school hall on 3rd January 2022 at 2:30 and agreed to moderator Mr. Pradip Karki, the role of facilitator first Mr. Lal Babu Gupta principal of Sitapaila secondary school, the role of the second facilitator to Mr. Avinash Karki other management as well.

In the opening of the focus group discussion, I thanked the students and teachers for giving me busy time. I introduced myself. The proposed group discussion is to find out the existing practice of digital technology, the opportunity, and challenges of using digital technology in mathematics learning. The whole discussion is based on existing practices of digital technology, opportunities, and challenges faced by students in mathematics learning.

Focus group discussion takes time nearly one hour thirty minutes they are free to put their exact experience and thoughts. Everyone got a chance for giving their answers one by one. Everything that participant expressed answers kept confidential and anonymous and used in my research study.

Moreover to get the answer to my first research question again I interviewed with mathematics teacher of the sampled school.

On Monday, January, 3rd 2022, I interviewed Mr. AvinashKarki mathematics teacher of Sitapaila Secondary School, Nagarjun-4, Kathmandu. The interview was taken after the student's exams of the ethnography qualitative research

The use of digital technology increases day by day in the education system. The use of digital technologies makes students creative, innovative, patient, goal-oriented, and actively participating. The mathematics teacher of Sitapaila Secondary School is active in the use of digital technology. Physical infrastructure and ICT lab are most important for the use and practice of digital technology in mathematics teaching and learning. For digitalized mathematics teaching and learning, the digital lab should be in school. Sitapaila Secondary School, Nagarjun-4 lies in the Kathmandu valley. Mr. AvinashKarki is a math teacher at Sitapaila secondary School. He has good experience in the use of digital technology and its effectiveness in teaching mathematics. He used Microsoft word, Microsoft excel, Microsoft PowerPoint, Microsoft Access, google, email, YouTube. He also uses mathematical software SPSS, Photo math he is not using Geogebra and Mathematica but he is still a self-learner to use Geogebra for mathematics teaching. He also used a hardware scanner, smartboard, projector.

He used to teach laptops with projectors to teach algebra shows related pictures of a different kind of formula, to teach geometry he used to laptop and projector to show different kinds of shapes and sizes, to prove a different kind of theorems. Some chapters of mathematics are taught by the traditional method.

Section II: Opportunity Gets by Students and Teacher Using Digital Technology

A good environment is important to factor in good learning. The classroom environment should be educational, practicable, and peaceful for study. For good learning of students, school environment should be a mixture of social value, culture, and education, friendly behaves safety, practice and organized structure and physical infrastructure and access internet most important for use of digital technology. The relationship among administration, teachers, students, parents is also responsible for a good learning school environment for students. For the practice of digital technology in education, the school environment must be friendly and physical infrastructure and digital infrastructure are the main factor for it.

It was the day of 3rd January 2022. I conducted a focus group discussion to answer my second research question. From the focus group discussion, there are numerous opportunity gets by students using digital technology in mathematics learning such as



Students can learn in various ways.In the traditional method students only get opportunities to learn from the teacher but now students can learn various ways like different kinds of websites, youtube, google, chrome e.t.c. If students are interested to learn mathematics s/he can learn from various ways and options to choose using digital technology.

Online resources.In general, web pages and documents on the internet that gives useful information is called online resource. Like- google chrome, khullakitab.

Student A said, "*I use youtube and online materials to learn courses and content related to solving mathematical problems that confuse me.*"

Student B views, "*obviously I use an online resource to learn about mathematical knowledge, so sometimes I use online resources to practice and clear the mathematical concepts at home too.*"

Students C and D said "*using online resources many mathematical problems can solve without others' help so I use technology.*"

From the focus group discussion above information of my participant, I came to know students are using an online resource and youtube to solve their mathematical problems, clear the concept of mathematical content.

Use of digital technology in the classroom. In this technological era, the use of digital technology in the physical and online classroom to learn mathematics has the most opportunities for students. The application of this related technology in the classroom depends on the teacher giving value to the technologies nature of learning mathematical content. In the classroom teacher used to teach mathematics, traditional method as well as digital technology according to the content he select method. He used the traditional method of teaching algebra, and technologies are used to teach another chapter like Geometry to show different kinds of shapes and sizes. He also used SPSS, different kinds of youtube videos, Microsoft office, projector, smart boards, laptops.

Student C told "*In a classroom, we are active participants in the classroom. Use of technology in the classroom more entertaining, clear the concepts of mathematics it helps to the finished course in time.*"

A network is a library. This is new approach has been driven by the availability of computers and networks which allow us to gather and analyze large-scale data and also by the breakdown of boundaries between disciplines, allowing us to uncover the generic properties of complex networks (Albert and Barabasi, 2021). It

is also important for the social network. The network gives us rich information about collaboration patterns. Students also use kind of collaboration patterns like Zoom, Microsoft teams.

Student A said, "*In a lockdown, we use the zoom app to study mathematics and other subjects to interact with teachers and with my friends.*"

Nepal's Government has targeted digital literacy 2025. Literacy is understood as one's ability to read, write and solve arithmetic problems. Digital literacy refers to an individual ability to find evaluate and communicate information through typing information and other media on various digital platforms. It is evaluated by an individual's grammar, composition, typing skills ability to share text, images, audio, and designs using technology. (Wikipedia)

According to digital Nepal framework 2019 in Education sector make visions smart classroom, online learning platform, Rent-a laptop programs, EMIS, mobile learning centers in rural areas. In a Sitapaila Secondary School, Nagarjun-4, there are smart boards, computer labs, projector, photocopy machines, Scanner, laptops, Internet connectivity. Students are also used to learning smart boards, projectors, laptops, and internet connectivity.

Principles Said, "*Projectors and laptops, computers are given by Kathmandu Metropolitan for increase digital literacy.*"

Constitutional rights. Constitution of Nepal part-3 has fundamental rights and duties. There are thirty-one fundamental rights. Right of communication has no means of communication including press, electronic broadcasting and telephone shall be interrupted except following law, people have right boardcasting news, properly use of television, radio, digital and electronic equipment and right of information

every citizen shall have the right to demand and receive information on any matter of his or her interest of public interest. (Constitution of Nepal,2072)

Student E says "*of course, we kept mobile, computer, internet and access of information this right is given by Constitution of Nepal.*"

A good environment is important to factor for good teaching and learning. Digital technology is a basic understanding tool to motivate students and to provide some



sense of how we can create this motivation. I asked my teacher participant in an interview about Digital technologies gives opportunities He shares his view as:

Autonomous learner. The teacher is always a self-learner. To teach a different kind of course and content of mathematics using digital technology he should be learning and practicing first. Students are also motivated to use digital technology to clear the concept of content. Students are more active and interact with each other, interact with the teacher. Nepal's government has given funds to develop digital literacy, technological tools, infrastructure, connectivity has proper utilization. Mathematics is an abstract subject. Mathematics gives an easy and early opportunity to make independent discoveries. The students must have opportunities for making their discoveries of mathematical ideas, but they must have the practice necessary to achieve accuracy in their calculations.

The teacher said, "*To use digital technology in mathematics teaching is a chance to learn me, mainly I use youtube to practice Geogebra but I did not use it in*

class because of less confidence I will be using Geogebra to teach mathematics in the classroom in future."

Training. The teacher gets a chance of online training. Due to the pandemic situation of COVID-19 at that time many institutes, teacher, groups of colleges has given training on how to use GeogebraMathematica and other digital technologies. To use digital technologies training is also given by Nepal Government as TPD divided into two phases the first phase has 15 days and the second phase also 15 days.

Time-consuming. The mathematics teacher of Sitapaila Secondary School used a laptop with projectors. He shows different kinds of pictures to relate different formulas to teach algebra and uses different kinds of shapes and sizes to teach Geometry. A picture speaks thousands of words like this using digital technology in teaching mathematics if we show content related pictures, tables or different kinds of shapes and sizes to clear the concept need not more description.

The teacher Said " *Using digital technology does not need more lecture it is easy to understand for students and easy to teach. It helps to the finished course on time students are also interactive active participants "*

From the above information, I found that teacher gets opportunities to use digital technology. The teacher got online training, using online resources to learn, using digital technology in the classroom.

From the Focus group discussion and interview I found that teaching and learning mathematics using digital technology is more effective and more interesting. It is student-centered learning that can assist to boost up their computers as well as lessons be learned meaningfully.

Section III: Challenges Faced by Students and Teacher Using Digital Technology

Digital technology in Education means teaching and learning by the use of digital technology. Digital technology is currently being used in education to assist students to learn more



effectively by providing teachers with access to a wide range of new pedagogy.

However, due to the slowness of the internet, lack of network connection, it seems that the students have difficulty in accessing the services through the internet. From the focus group discussion, there are numerous challenges faced by students using digital technology in mathematics learning such as

-) Insufficient of infrastructure
-) Lack of connectivity
-) Lack of good economy
-) Lack of electricity
-) Suffering from eyes problem

Lack of infrastructure.In focus group discussion there are twenty-one students. Eighteen students have smartphones and five students have normal phones. Some students have a laptop, computers in their homes.

Student A said that "*she has only one smartphone on her home most of the time her father use that mobile. She used mobile to look youtube, google learn mathematics but she can't use herself.*"

Student B said " *He has not a smartphone, laptop and computer on their home to use technological tool sometimes he used others mobile and laptops.*

Lack of connectivity.All students are using the internet (wifi, data). They are also using various types of social sites like meta, messengers, WhatsApp.

Students C said " *He has no wifi at home they use sharing wifi if electricity is gone there is no other option and another D students have also same kind problems"*

They are facing numerous problems of connectivity poor connection, disconnection, cut off electricity. They can't afford the data every day because of the low balance on their mobile. Data are heavily costly. Sometimes some students used mobile data to learn mathematics through google and youtube there are also connectivity problems low connections, disconnecting, a signal of connectivity.

Lack of good economy.Most students of Government schools students belong to a middle-class families. Three students have no smartphones they have no computers and laptops in their homes due to the good economy. Their parents work on building construction and agriculture.

Lack of electricity.Nepal is still behind in development there is a lot of problem about the electricity. Most of the hills and Himalaya region have not reached the facility of electricity. In a Kathmandu valley everywhere reach the facility of electricity but also cut off electricity is problems. In students' homes, there is no availability of generators.

Suffering from eyes problem.From the focus group, discussion students are not familiar with digital technologies they have enjoyed the traditional method due to the eyes problem. The projector is brighter than whiteboards and much time spent on learning by digital technologies (Projector and mobile) in class or during online class they are suffering from many kinds of eyes problems.

Student F said, "*Long time use of mobile, computers, projectors lights effect eyes.*"

Using digital technology for teaching mathematics is not easy. Most schools are less prepared for it in rural areas so I selected Kathmandu valley for research. From the interview, I found that lots



of problems faced by the teacher as students. Challenges faced by the teacher are:

Insufficient subject technology-specific training. The successful and effective use of digital teacher training is most important. To use properly digital technology need experience teacher unless the teacher is comfortable with a new approach to teaching, providing students with computers. The teacher is newly appointed because engineering classes start from class-9 he has an engineering background. He has not gotten a chance training to use digital technology because the school has no proper schedule for teacher training related to the use of digital technology. Training should be very important for professional development it also helps students' learning and achievement. Mathematics becomes an essential subject for everyone in almost every field. Mathematics is the heart of every field most of the work is done with help of mathematics.

The teacher said, "*I don't get any mathematical subject-related training through the School as a subject teacher but I got training from online.*"

Insufficient support of Administration. The administration often supports economic and physical construction and purchase digital technological tools. All the

facilities of the school depend on the economic status of the school. The school has not an additional source of income.

The principal says " *We are getting financial support from Kathmandu metropolitan and Nepal government. There is a low budget to maintain the computers, projectors, and smartboards.*

Lack of technology access. For effective teaching and learning mathematics using digital technology is determined by the availability. In school, five rooms have an available projector, smartboards and one is a computer room. Mathematics teachers use a laptop with projectors, and smartboards to teach algebra and geometry. To use this he uses another room because not all room has facilitated technologies tools.

The problem of time management. The use of technology for teaching mathematics in the classroom requires more preparation time for the teacher, more teaching materials/applications, and more time for making PowerPoint. In the school, there are also 10-4 duties more than five periods for teaching so one of the challenges is time management.

In conclusion of focus group discussion and interview teacher and students are enjoying using digital technology in teaching-learning mathematics but numerous challenges are facing both teacher and students. Challenges are related to the socio-economic condition, access, infrastructure, use of technology training e.t.c.

According to Downes and Sieman (2003), knowledge travels around networks of connections, and learning consists of the ability to travel those networks. Learner conducts their knowledge by connecting to information sources, searching for knowledge, gathering knowledge in devices. Connectivism theory in the digital age theory. Students can learn through informal. The main goal of connectivism theory is

students' ability to do something. They learned from the course, Email, Forums, blogs tweets, projects, youtube. The teacher's role in teaching-learning activities of mathematics is nurture.

From the focus group discussion and interview I concluded that students and teachers are using online resources, youtube, google, many social sites to teach and learn mathematics.

ChapterV

FINDINGS, CONCLUSION AND IMPLICATIONS

This chapter is concerned with deriving some findings from the discussion of the previous chapter. Besides findings and conclusion, It has some implications which will be useful for further studies and the sector.

Findings of the Study

The specific objectives of this study were to explore the existing practice of digital technology in teaching-learning of mathematics, find out opportunities and challenges of the teacher using digital technology in mathematics teaching, and to explore opportunities and challenges of the students using digital technology in mathematics learning. The use of digital technology in mathematics class and school sector increases the interest of teachers and students, it contextualizes the content, visualizes the content in mathematics education. Digital technology helps to visualize the content so that the classroom becomes more interactive and interesting, and it also connects the classroom's national and international collaborative partner classes. Different mathematical software, youtube videos, and other online resources, the internet could help students for the conceptual learning, it refers our students for self-learning, it refers students for the self-learning and also connects the teachers from worldwide in a moment, due to process and the process and the learning ability in the digital technology. Digital technology tools support visualization of mathematical concepts in various ways of expressions and as such may foster versatile thinking, especially when these representations are dynamically linked. Digital technology tools have a positive impact on mathematics students learning. Students are engaged, thus students 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 students including mathematics, reading, and research.

To meet the objectives of the study, Sitapaila Secondary school Nagaarjun-4, Kathmandu, were visited for a week-long to collect data, Ethnography approach among qualitative research design method was adopted for this study. The data were collected through interviews, classroom observation, focus group discussion. One mathematics teacher and class-10 twenty-two students. Literature on mathematics teaching and learning shows that there is a consensus on the need to enforce our student's problem-solving and high order thinking skills in mathematics so that they can be captured in pursuing a successful career. As a connectivism focused on realistic and interactive learning, the sampled students also perceived figures in mental interaction, which is called connecting mathematical language to natural language. Students felt easier to make the conceptual framework of mathematical abstract contents with the help of geometrical figures generated from Geogebra. The major findings of the study were;

Findings Related to Existing Practice of Digital Technology

-) The study found that the use of digital technology is evolving in schools.
-) Students are less involved in using digital technology in the classroom. They are only using YouTube and google for solving mathematics.
-) The teacher used both usual and digital technology to teach mathematics in the classroom. He demonstrated pictures and instruction materials while teaching mathematics and different kind of formulas, he demonstrated the mathematics lessons via laptop, projector.

Findings Related to Opportunities of Using Digital Technology

-) The opportunity gets by students using digital technology are students can learn various ways, online resource, the network is a library for collaboration pattern of learning, Nepal government has targeted digital literacy 2025.
-) . The opportunities get by the teacher to use digital technology as an autonomous learner, online training, online resource.
-) Some students feel digital technology is more flexible to learn at their own pace as well as interest some prefer the traditional way of learning.
-) Available technologies are used effectively by mathematics teachers but due to the low financial condition of the school, every room has no technological tools.
-) 15 students have enjoyed power points which made interesting and long-lasting learning and six students are like whiteboards and markers way due to the eyes problem.

Findings Related to Challenges Using Digital Technology

-) Various policies and provisions have been formulated for the development of digital technology have been formulated for but its practical implementation is going slowly.
-) The digital environment of the classroom is not satisfied.
-) The challenges faced by students using digital technology are lack of infrastructure, lack of connectivity, lack of good economy, lack of electricity, suffering from, eyes problem and lack of implementing policy and programs.
-) Low financial condition and income source of students are influencing for relevant digital technologies tools according to as required.

) The challenges faced by the teacher to use digital technology are more related to environment and infrastructure, training.

We have been facing a pandemic situation since 2019.

) The effective use of digital technology during pandemic situations took a vital role in teaching and learning. Mathematics teacher and students are using digital technology.

Conclusion

This is ethnographic research. The researcher herself developed the questionnaires under the guidance of the supervisor. The questionnaire, classroom observation, interview, and focus group discussion were the main tools of my study. The responses were mathematics teacher and students of class-10 Sitapaila Secondary school, Nagararjun-04, Kathmandu, selected by purposive sampling method. Open-ended questions were included in the category of problems, and inductive analysis of collected responses was carried out. The triangulation method, member checking, field observation for the analysis, and such analysis were authenticated by ethnography qualitative data obtained by class observation form, interview, and focus group discussion. Digital technology provided great opportunities for schools in developing countries to improve teaching and learning. COVID-19 pandemic boosted the use of digital platform encouraged schools. When closed the school and face-to-face classes due to the nationwide lockdown.

In conclusion opportunities and challenges of digital technologies in teaching and learning mathematics, both teacher and students are facing numerous opportunities and challenges to clear the concept of mathematics. Both are using youtube, an online resource, google chrome. All students and teacher know about the effectiveness of digital technologies, but at the same time, the physical infrastructure

of the school and home environment were not satisfied. Therefore, we need to increase the use of digital technology in mathematics learning to make learning effective, the physical infrastructure of the school, the policy and provisions as well as the effective implementation.

Educational Implications

Technology is essential in teaching and learning mathematics. The result of this study could have an implication on the teaching-learning of mathematics at the school level. The following study should be carried out to make the result of the study complete. Further researchers can touch guardian's perspectives and it would help roles digital technology in mathematics education be student-friendly.

Pedagogical Implications

-) To make mathematics technology-friendly, the school environment should be made technology-oriented along with the home environment.
-) Institutions or the government should motivate the teachers to attain training regarding the use of ICT academically the teachers.

Policy Implications

-) Government and non-government sectors should be able to take necessary initiatives to develop schools and universities as free Wi-Fi sectors. School is equipped with projectors for technical education, they have been used effectively.
-) For technological friendly teaching and learning, there are many opportunities along with challenges so we must focus on implementing the opportunities while facing challenges.

-) To connect mathematics with digital technology various national and international seminars, webinars and workshops should be organized and students should be involved.
-) Various policies and provisions have been formulated for the development of technology in teaching and learning but its practical implementation is not satisfactory so it is necessary to emphasize the field of implementation. Students should not be worried about the exam if they do have a clear understanding of the mathematical concept through the use of digital technology.
-) Students can gain clear concepts and they can explain both the facts and concepts to the students for understanding abstract ideas later.

Recommendation for the Further Study

This is the ethnographic study of grade 10 students for opportunities and challenges of digital technology in teaching and learning mathematics. The research had consisted of only class 10 students of Sitapaila Secondary School and one math teacher. Research on a large scale is needed to see if the finding of this investigation can be generalized to other such types of studies.

-) Effectiveness of digital technology in teaching-learning
-) Opportunity and challenges of online classes
-) This type of research can be conducted with large sample size and various schools of Nepal
-) This type of study can be conducted on the basic level and higher level
-) This type of research can be conducted in private schools.

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Appendix

Interview Guidelines

School's Name-

Teachers Name-

Gender-

I. Sir, Please tell me about digital technology use in the classroom?

II. Sir, Do you use

	Yes	No
Microsoft word		
Microsoft Excel		
Microsoft Powerpoint		
Microsoft Access		
Google		
Email		
Youtube		

III. Do you use mathematical software and hardware to teach mathematics?

If Yes:

	Yes	No
Software		
Geogebra		
Mathematica		
SPSS		
Photo Math		
Hardware		
Scanner		
SmartBoard		
Projector		

IV. What are the existing practices of digital technologies mathematics in teaching at the secondary level?

- V. Do you use an online resource to teach mathematics?
- VI. How much do you feel the use of digital technology helped?
- VII. Sir, You have experience of using the strategy as well as digital technology which one will you choose if you have to?
- VIII. What are the opportunities you get while you teach mathematics by using digital technology?
- IX. What are the challenges faced when you teach mathematics using digital technology?

Focus Group Discussion

Student's Name-

Class-

Gender-

Age-

I. Do you have?

Phone		
Laptop		
Computer		
Internet		

What is the infrastructure of digital technology in your classroom/school?

II. Do you use any mathematical software to clear concepts?

If Yes:

What kind?

III. Do you use an online resource to learn mathematics?

IV. Is the learning environment collaborative and encouraging while using digital technologies?

V. Do you feel digital technology improved your understanding of learning mathematics and making your learning easier?

VI. Did you enjoy using digital technology? Why?

VII. What are the opportunities to use digital technology in mathematics learning?

VIII. What are the challenges of using digital technology in mathematics learning?

IX. Is there anything else anyone would like to share?

Observation Guidelines

School's Name:

Class:

Total no. of students:

Subject:

Topic:

- I. Practices of Digital Technology
- II. Interactions of Students- Students
- III. Interactions of teacher and students
- IV. Effectiveness of digital technology

S.N	Students Name	Using Digital Technology	Topic	Participation		
				Active	Moderate	Passive