VIRTUAL LEARNING IN MATHEMATICS EDUCATION: A CASE STUDY

A

THESIS

BY

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Letter of Certificate

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LETTER OF APPROVAL

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M. Ed. thesis entitled **"Virtual Learning in Mathematics Education: A Case Study"** under my supervision during the period prescribed the rules and regulations of Tribhuvan University, Kirtipur, Kathmandu, Nepal. I recommend and forward his thesis to the Department of Mathematics Education to organize the final viva-voce.

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Dedication

*This thesis is dedicated to my father **Mr. Lal Bahadur Budhathoki,***

*my mother **Mrs. Khemusara Budathoki,** and my wife **Mrs. Radhika KumariBist**.*

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

complete this research.

Declaration

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

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Date :12th Sept., 2021   ChhetraBahadurBudhathoki

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Abstract

This research study entitled "Virtual Learning in Mathematics Education: A case study" was carried out to identify the views of students on Virtual Learning in mathematics education. The main objective of this study was to explore secondary level students' attitude on Virtual learning during pandemic situation and to analyze the opportunities and challenges of Virtual learning. Two mathematics teachers and four students of secondary level were selected as the sample of the studies.

To achieve this goal, I had chosen school as a sample by the name "UjjwalShishuNiketan Academy" of Kirtipur, Kathmandu where I have been teaching for last two years. Case study approach among qualitative research design method was adopted for this study. The data were collected through interview schedule and class observation forms. The collected data were analyzed and interpreted by different theme based on conceptual framework and generated the different code according to the response of participants.

The researcher found the challenges faced by students while they were taking virtual classes are unstable network services, lack of motivation, lack of technical knowledge, notification distraction, useless notification, shortage of devices, unnecessary advertisement, expensive gadgets, learner's capability & confidence level, time management, distractions, frustration, anxiety & confusion, lack of personal/physical attention and complexity. The most frequent barrier respondents noted was the lack of reliable internet at home and the opportunities entertain students while taking online classes are time flexibility, location flexibility, scope for innovation & digital development, wide availability of courses & content, immediate feedback, with no boundaries and self-learning are the opportunities while students were taking online class of mathematics education.

In the conclusion, while preparing this thesis, due to COVID-19, all colleges and schools were duly closed and classes were conducted online that made all parties aware of virtual learning. They are in favor of using virtual learning. Their responses show that virtual learning is needed for better learning in the future. Only a negligible

number of students have negative perceptions, misconceptions, misunderstanding and illusions towards virtual learning. Overall, the students had a positive attitude towards virtual Learning. The various aspects of virtual learning tools visually, dynamic in nature help students to provide more depth understanding of quantitative techniques. The students received immediate feedback with the help of virtual learning. Students were very much impressed and excited to know about the quantitative techniques based on software. The qualitative data revealed that student were facing various problems while using virtual learning at secondary level. They were related to devices (computers, mobile phones) and internet connection, their knowledge and skill, time as well as financial support, lack of infrastructure, trained instructors.

The students recommended that the teachers need training on how to take virtual classes effectively. The challenges for the virtual teaching can be minimized if the teachers are well trained for virtual education system. Virtual teaching education if integrated with traditional classroom, lectures for selected topics could be beneficial to the students. Internet facility is necessary and should be improved to learn virtual in mathematics education effectively and policy makers should provide additional planning time for students to experiment with new ICT-based approaches.

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Chapter I

Introduction

This section includes introduction of Virtual Learning in Mathematics Education, statement of the problem, objectives of the study, research questions, significance of the study, delimitations of the study and operational definitions of the key terms. These components are presented as following.

Background of the Study

Since December 2019, the world has witnessed a radical change in all spheres of life. From the time when the first case was recorded in Wuhan China, the current pandemic called Novel Corona virus has become the first-class topic of debate amongst individuals, public, non-government institutions, on the social media, internet and in the news around the world. Unfortunately, statistic associated with the spread of the pandemic has continued to rise in many countries like the United States of America, and Canada and in other continents including Europe, and Africa (World Health Organization, 2020; New York Times, 2020). This pandemic has brought many changes across various industries and about how people live, socialize, and run daily activities (Coulthard, 2020). With the quick response from many governments around the globe, almost everything is being cancelled, shutdown, and postponed. Schools, universities, all public, and private events are being prohibited; social distancing is observed as proactive efforts put in place to contain the further outbreak and spread of the Corona virus in more than one hundred countries of the world. Millions of the students in Nepal and around the globe became out of the face to face classroom by learning from home. It must be noted that with the outbreak of the virus, all things have changed; the teaching and learning practice has come into the home now. For these students to continue with their education, all classes went online, millions of students have begun learning through the internet and digital tools. Therefore, online education is considered as an essential tool for simplifying the teaching and learning process.

Technology is a vital component of teaching and learning in the 21st era. The expanding use of technology in teaching and learning has improved methods of teaching from traditional to the most flexible methods, (Sun & Chen, 2016; Onyema& Deborah, 2019). Technology influences remote education, virtual learning, distance

learning, mobile learning, cooperative learning and machine learning. Each aspect of education is adopting digital, and students, as well as education stakeholders, are challenged with the transition to online learning. The application of technologies in education increases the accessibility to learning resources such as virtual courses and many other programs to meet the need for distance learning (Onyema, 2019). Nguyen (2015) has defined virtual learning as a wide range of curriculums that practice by using the internet to facilitate instruction and provide materials as well as interactions between teachers and students or among the group of students. On the other hand, virtual education conceptualizing as a general way of teaching and learning online with the help of digital platforms and technology tools. Virtual education noted virtual teaching and learning originates from development of digital technologies which facilitate instructional activities by using the internet. The success of learning online depends on digital skills, availability of educational technologies and good internet networks in the learning environment. There are many platforms or tools that educators and learners use in virtual learning. Some of these technologies are Zoom, MS Team, Google Meet, WhatsApp.com, and Skype.com, Youtube.com, and Google classroom. The application of these technologies in education influence virtual learning and accessibilities of learning and teaching materials through the internet. The internet has made teaching and learning conceivable, and many educators and scholars are interested in virtual learning to enrich accessibility of learning resources and improve students' learning, mainly in Higher learning (Horn &Staker, 2011), portrayed that online learning is a form of distance education which has been practised in America and has become the most important aspect of distance education in recent years.

In virtual mathematics courses, the display of the mathematical concepts, problems and process steps of the solutions and effective realization of the student-teacher interaction are two factors that affect learning outcomes (Karal et al., 2013). In learning about ways of mathematical thinking, logical inference and discussion of alternative solutions via student-teacher interaction constitute the basic principles of mathematics education (Baki, 2006). In addition, writing is a must for doing mathematics (Artemeva& Fox, 2011). Radford (2008) emphasized that mathematical thinking occurs through a sophisticated semiotic coordination of speech, body, gestures, symbols, and tools. In virtual distance learning, students and teachers are

integrated into the system via computer; the computer screen is used for reading and the keyboard for writing (Bernhardt et al., 2004). It is difficult to achieve sufficient interaction in an virtual learning environment by displaying mathematical concepts and symbols, which play a significant role in mathematics education, solely through use of a keyboard. This seems to be a limitation in the process of learning mathematics by online learners. Prior research reveals that mathematics instructors can have difficulty when explaining mathematical concepts visually in blended and online distance mathematics course (Glass & Sue, 2008; Karal et al., 2013).

With the beginning of the lockdown to control the Covid-19 outbreak, many educational institutions have started switching from traditional classroom teaching to virtualteaching to cope with the adverse situation. Tribhuvan University (TU), the largest and oldest university in Nepal, has also officially endorsed the virtual class model along with a guideline and circulated a notice among its institutions. Similarly, the Ministry of Education, Science and Technology has appealed to stakeholders to start classes through alternative systems. Various news media and relevant stakeholders have argued for the need for promoting such classes.

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

mathematics virtual learning is more complex rather than other subjects. Therefore, these profiles mentioned above help to measure the virtual learning during pandemic situation in mathematics education**.**

Nowadays, the students of mathematics education have been aware about the facilities and the academic excellence of the institutions. Students are not satisfied with the traditional teaching learning approach. There is a demand of ICT based teaching and learning. The academic achievement of students is decreasing day by day. In this context based on the reality this research has tried to identify the factors which affect the students' satisfaction and it may be helpful to make strategic planning and to motivate the students of secondary level in the days to come.

1.2 Statements of the Problem

This research study attempts to find out to better understand student perceptions about virtual learning during pandemic situation in mathematics education. Specifically, the purpose of this study is to explore secondary level students' attitude on Virtual learning during pandemic situation. Moreover, a purpose is to analyze the opportunities and challenges of Virtual learning. Nepal is a developing country, which is still behind in employing technology for learning mathematics. The government of Nepal emphasize integrating technology in virtual teaching and learning mathematics (MOE, 2072) and Tribhuvan University, the largest and oldest university in Nepal, has also officially endorsed the virtual class model along with a guideline and circulated a notice among its institutions. Similarly, the Ministry of Education, Science and Technology has appealed to stakeholders to start classes through alternative systems. What are the students' attitude towards: virtual learning in mathematics education, teaching learning activities of virtual mathematics classes, availability of internet facilities and evaluation system of virtual learning mathematics? are the research problems of this study.

The advent of new technologies is providing educators with opportunities to create a variety of effective learning environments; however, many students still prefer traditional, academic settings. However, a major barrier to the growth of virtual courses is low retention rate across all types of institutions (Allen & Seaman, 2013). As more students are growing up familiar and comfortable with internet-based technologies, many students are still opposed to taking virtual mathematics courses. A need exists to examine the challenges students perceive, and what can be done to meet student expectations. Students are increasingly being offered virtual educational

experiences, whether through hybrid mathematics learning environments or a shift in greater use of technology even in the traditional classroom environment. Thus, a need to define the real difficulties that students have in taking virtual mathematics courses exists along with determining pedagogical approaches that can address those difficulties and increase the likelihood of a successful online teaching and learning. This current research identifies and builds upon specific areas of virtual mathematics education that students perceive to be unclear or ambiguous and thus present barriers for their successful learning.

This research also focuses on analyzing student perceptions of virtual classes in mathematics education. Little research exists that provides an analysis of student approaches between these groups of students in a single study. The purpose of this study to explore secondary level student's attitude on Virtual learning during pandemic situation, to analyze the opportunities and challenges of Virtual learning, and offer suggestions for improving the virtual learning environment.

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 explore secondary level students' attitude on Virtual learning.
2. To analyze the opportunities and challenges of Virtual learning.

Research Questions

The Research questions of my study are:

1. What are the challenges do students encounterwhile taking virtual class in mathematics education?
2. What are the opportunities that students entertain while taking virtual class in mathematics education?
3. What are the students' attitudes on virtual learning?
4. What is the students' perception about quality of virtual classes in mathematics education?

Justification of the Study

Each and Every study is important for the institutions, scholars, professors, students and the researchers who are interested in this area. This study will reveal virtual learning in mathematics education. Similarly, it will also display students' challenge and opportunity to virtual learning in mathematics education in the context of Nepal. So, this research study will be significant to the students who are learning mathematics by virtual classes and reform their way of learning. 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.

The use of online classes in mathematics education can make the teaching process more effective as well as enhance the students' capabilities in understanding basic and innovative ideas about every branch of mathematics. This study has following significance.

) To understand the attitude of students towards virtual learning during pandemic situation in mathematics education.

) To analyze students' challenges to virtual learning mathematics in the context of current literature on virtual classes

) To analyze the opportunities that students entertain while taking virtual class in mathematics education.

) It is also helpful for improvement in the teaching learning situation in the context of negative attitude and further research towards virtual mathematics classes.

) This study provides the important information to the instructor in applying virtual learning in mathematics education.

) It is helpful for national policy makers, mathematics curriculum developers, administrators, and all other concerned individuals.

Delimitations of the Study

Delimitations are boundaries that are set by researcher in order to control the range of the study. The proposed study will be limited to the following aspects:

This study was concerned in secondary level of UjjwalShishuNiketan Academy in Nepal.

This study was included only with the secondary level students of mathematics education.

This study was limited to the virtual learning pandemic situation in mathematics education.

The study was limited to the data collection from in-depth interview and observation.

This study was limited in Kathmandu Valley.

This study was based in qualitative research.

Operational Definitions of the Key Terms

Operational definitions are such types of terms which decide to measure the variables in the study. In another way operational definition is the articulation of operationalization (or statement of procedures) used in defining the term of a process needed to determine the nature of an item or phenomenon and its properties. In this study the following are the operational terms of the study.

Virtual learning ÷ Virtual learning is a course conducted over the Internet. They are generally conducted through a learning management system, in which students can view their course syllabus and academic progress, as well as communicate with fellow students and their course instructor.

Pandemic Situation÷ The 2019 COVID-19 outbreak is a viral pandemic that's currently ongoing. This is a new illness caused by a previously unknown coronavirus. The infection rate, mortality rate, and other statistics are still developing.

Secondary Level Students÷ The persons who have studied in secondary level of UjjwalShishuNiketan Academy of Nepal.

Virtual course ÷ "A course where the instructor has replaced all in-class instruction with virtual instruction. Students and instructors never come to class" (GVSU, 2015).

Attitude ÷ Attitude is a way of feeling or thinking towards a person, thing or situation such as positive and negative.

ICT÷ ICT stands for "Information and Communication Technologies." ICT refers to technologies that provide access to information through telecommunications. It is similar to Information Technology (IT), but focuses primarily on communication technologies. This includes the Internet, wireless networks, cell phones, and other communication medium.

Chapter II

Review of Related Literature and Conceptual Framework

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 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 have collected some books, journal, seminar paper, thesis, articles, researches which are related to relevancy of online classes in mathematics education. By deeply studying of these resources, I am going to review the related literature as follows;

Theoretical Literature

A theoretical framework guides research by sing 'what work' in the experience or exercise of doing something by those directly involved research studies. After reading literature, a number of theories have been developed from different perspective. The information has been obtained from different literature which is sorted under the main themes and stories:

Constructivist theory

The literature reviewed and the associated problems and possible solutions that answer to student perceptions about virtual learning in mathematics education

align with the Constructivist theory and its teaching models. Murphy (1997) summarized 16 characteristics of Constructivism, three of which are primarily represented in this review of the literature:

⟩ Teachers serve in the role of guides, monitors, coaches, tutors and facilitators;

⟩ Student problem-solving, higher-order thinking skills, and deep understanding are emphasized;

⟩ Learning takes place in individual contexts and through social negotiation, collaboration and experience. Koohang (2009) adapted Murphy's (1997) characteristics into an advanced model of Constructivism in e-learning environments.

The three components determined are:

⟩ Design of Learning Activities, which includes collaboration, cooperation, multiple representations of ideas, and social negotiations;

⟩ Instructor's Roles, which are mentoring, acknowledging, providing feedback, and assessing student learning;

⟩ Learning Assessment, either conducted by the instructor, through collaboration, or by the student himself.

Educational technologies are used not just to control learning, but the main purpose is to make the learning process easier by creating an effective learning environment (Jackson, Jones, & Rodriguez, 2010; Januszewski&Molenda, 2007). Thus a Constructivist model applied to educational technology would encourage more creation within learning environments and avoid using technologies to control learning (e.g., presenting information and delivering drills and practice). Theoretically, technology is more useful when it is used by students to identify a problem with the appropriate tools for the purpose of supporting learning.

Communication

Communication can occur synchronously or asynchronously. Synchronous communication means the communication is taking place in real time, as would be found in a traditional, face-to-face classroom. Methods of accomplishing similar communication in an online course would require videoconferencing or virtual sessions. Examples of programs that facilitate synchronous communication are Blackboard Collaborate, ooVoo, and Google Hangouts. Asynchronous

communication happens when there is a time delay between initiated communication and subsequent responses between an instructor and students or between students. Examples of asynchronous communication methods are email and discussion boards. Both synchronous and asynchronous activities allow students to exchange ideas with other students and with the instructor, which is why better understanding of the barriers students face specifically related to communication and collaboration is important.

Synchronous communication

Real time communication between students and an instructor is supported in an online environment by many features such as audio, video, text-chat, interactive whiteboards, application sharing, instant polling, emoticons, and breakout rooms (Martin & Parker, 2014). However, there are no suggestions for implementing the whole array of functions available in educational tools in order to make a virtual class engaging for students. When given access to synchronous communication tools with a variety of functions, students have a tendency to exploit the array of features, and when technical problems occur, they can easily go beyond the limits of what an instructor can troubleshoot (Warden, 2013). In fact, utilizing too many technical features ultimately creates a work overload for an instructor (Warden, 2013). Instructors benefit from determining technical features that are most beneficial to students and their learning, and not providing too many options.

Videoconferencing can be successful because it provides a platform for students and instructors to communicate with body language and nonverbal communication in addition to words and other traditional teaching techniques such as demonstrations, screen sharing, and presentations online (Wang & Reeves, 2007). However, care must be employed because students can become distracted or confused in a virtual environment (Warden, 2013). Although students are well versed in watching video on demand and playing immersive video games, they lack experience in formal synchronous learning environments (Cole, 2009). Warden (2013) describes the various issues that arise from students who passively engage with technology from failing to download material to not learning to use software prior to class. Instructor intervention is needed to provide students with technical support or instructions on receiving support elsewhere. Instructors and students benefit from understanding what to do if audio or video are not working properly (Martin, Parker, & Allred, 2013).

While research for synchronous video communication is lacking in the literature, relying solely on a videoconferencing tool creates an environment for passive participation, and a lack of alternative options for communication means students' technical problems can be difficult to solve or even explore (Warden, 2013). Wang and Morgan (2008) found the strongest effect of instant messaging in videoconferencing tools was that instant messaging promoted a higher degree of student cooperation. While technical problems are associated to a greater extent with synchronous communication tools because of bandwidth requirements and commonly poor audio quality (Warden, 2013), a few additional tools can be used, such as instant messaging and instructional slide presenters, to maintain student focus, promote cooperation, and allow for alternative means of communication.

Asynchronous communication

Participation in discussion boards, wikis, journals and blogs is associated with a wide variety of cognitive and social activities (Gao, Zhang, & Franklin, 2013). Thus, most online courses utilize asynchronous communication tools. Gao, Zhang, and Franklin (2013, p. 472) explain that meaningful participation in a discussion board requires the following four characteristics:

- Discuss to comprehend;
- Discuss to critique;
- Discuss to construct knowledge;
- Discuss to share.

Thus, students should be able to contribute various perspectives and thoughts in an online setting, and in turn receive critique. Consequently, discussion should ensue to build knowledge and understanding. When any of these components are missing students are restricted in sharing their ideas, and this environment can quickly become superficial or artificial. The purpose of asynchronous communication is to promote peer interaction and facilitate the sharing and distribution of knowledge and expertise among a group of learners. Thus, creating online communities where students work together to achieve common academic goals and work towards objectives related to the coursework is a purpose of online teaching (Mackey, 2007).

Some students require additional support with postings, articulation of ideas, and overall communication in the class. A student in Chen, Bennett, and

Maton's(2008, p.315) study stated, "Everyone talked about their own situations and their opinions, and without the teacher's comments, I didn't know whom to listen to." When class discussion is taking place, the instructor must participate; otherwise the forum can easily appear to be disorganized. For example, Licona (2011, p. 7) writes that, "Pedagogical practice is informed by the immediacy of action and presence of instructor in the online learning space, thus fostering collaboration in numerous ways." In order to increase student participation, an instructor can ask questions and provide feedback directly related to a student's contribution (Durrington, Berryhill, & Swafford, 2006). Instructors should participate in discussion boards in order to motivate and encourage students to continue to participate.

Several tools are needed to keep students engaged and motivated in collaboration with other students. When using collaborative tools as a form of measurement of participation, one tool can likely be too limiting (Gao, Zhang, & Franklin, 2013). Most students currently use social networking skills for fun or consumption purposes, not for engaging in communal learning behavior with other students (Cole, 2009, p. 145). As are instructors should create a space and exercises for students to practice editing, publishing, and posting content through any communication tool being utilized (Cole, 2009).

Asynchronous communication tools are much more prevalent in the literature compared to synchronous tools. This lack of research on synchronous tools may be the result of perceived technical challenges. Regardless of the communication structure, students' technical and personal constraints in addition to a general lack of interest, limit their participation and contributions to these virtual communication platforms (Cole, 2009).

The theory of Constructivism was chosen as a theoretical basis for examining student perceptions and barriers to virtual class and the opportunities that students entertain while taking virtual class in mathematics education. This theory suggests that students can effectively build their knowledge based on prior experience and class activities (Januszewski&Molenda, 2007). In this study the theory is based on using technology in the creation of effective learning environments. Building collaboration between the instructor and students is known to be a crucial component of an online class (Durrington, Berryhill, & Swafford, 2006; Gao,Zhang, & Franklin, 2013; Martin & Parker, 2014). An instructor can use many supporting materials to

deliver content. These tools can be created and disseminated using various technologies. Questions remain about the combination of tools that can make the learning process motivational and effective for students. The instructor or course designer should understand supporting materials to help students learn information clearly while successfully meeting the learning goals. The tools that students are comfortable using in an online course must continue to be examined. With stronger data about student perceptions to the relevance of online classes for learning mathematics education, instructors can gain knowledge about building more effective online mathematics courses and experiences that motivate students to learn and advances their knowledge and skills.

Social Constructivist Learning Theory

Social constructivist learning focuses on the effects of social interactions, language and culture on learning. Vygotsky argued that all cognitive functions originate from social interactions. This interaction is very important in a learning process which connects well with virtual learning mathematics groups. Social constructivism explains the processes of learning in three concepts: the zone of proximal development, inter subjectivity and enculturation (C. T. Fosnot& R. S. Perry, 2005).

) The zone of proximal development was defined by Vygotsky as "the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance or in collaboration with more capable peers"(L. S. Vygotsky,1978). This is applicable with learning groups since the more knowledgeable peers can help in scaffolding others. This is equally applicable when the facilitators extend help to the learning group members. Facilitators do this through provoking the learners within the groups through questioning to assist learning.

) Inter-subjectivity is the mutual understanding that is achieved between people through effective communication. This is in agreement with virtual learning mathematics groups which require effective communication during interaction.

) Enculturation is the process whereby the currently established culture enables an individual to learn the accepted norms and values of the culture or society

in which the individual lives. Through social interaction, learners can co-create solutions in what is called collaborative working which leads to collaborative learning

George Siemens' Connectivism Learning Theory

This paper will apply George Siemens' Connectivism Learning Theory (Siemens, 2005) to a variety of educational settings and illustrate ways in which educators and academics can and have used technology platforms to share their work and engage in public conversations. George Siemens' Connectivism Learning Theory was written on his blog, elearningspaces.org, originally in 2004. Over the next year he received feedback from other academics, and in 2005 updated the theory based on feedback from others. Today this learning theory has been adopted by institutions of learning and has created the Massive Open Online Courses (MOOC) movement. Many institutions of learning that understand the changing landscape of how people learn, where they learn, and what they want to learn, have created websites like Edx, https://www.edx.org/, where anyone can take a course and/or engage in public discourse around a given topic. These MOOCs create a community of learners who continue to push the conversation forward. Siemens' Eight Principles of the Connectivism Learning Theory:

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 is 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.

While connectivism provides a useful lens through which teaching and learning using digital technologies can be better understood and managed, further development and testing is required. There is unlikely to be a single theory that will

explain learning in technological enabled networks. Educators have an important role to play in online network learning.

Therefore, all the domains of this research: challenge and opportunities of virtual learning in mathematics education, teaching and learning activities in virtual learning, availability of internet, learning strategies and tool and learning output are completely related to constructivism theory that emphasis the active role of learner and teacher role as an instructor or facilitator. All in all, virtual classes for learning mathematics supports constructivist pedagogy where student use technology to explore and reach understanding of mathematical concepts where it promotes higher order thinking and better problem solving strategies.

Empirical Literature

Every researcher needs to observe the fundamental background of the related subject and past studies. An empirical review in research methodology is when the writer reviews the information and theories currently available concerning the topic and the historical background of the topic. The point is to do two things. First, it is to demonstrate through understanding of the field in which she/he is conducting research. Second, it is to show that the problem being studied has not to be done before or has not been done before in the way proposed by the writer.

This study provides information of previous research and other related literature on virtual learning during pandemic situation in mathematics education. The aim of reviewing the previous researches and literature (like Article, Journals, seminar paper, conference paper) is to explore what has already done before and what is left to be done in the very realm.

(Burke, 2020) the authors posited that virtual 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 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 virtual learning during pandemic situation in mathematics education.

Brown and Liedholdm (2006) A study conducted with undergraduate microeconomics students at the University of Michigan showed virtual learners spend less time working on class materials than students who attend a face-to-face class, which could attribute to less success in an online learning environment.

Results of Brown and Liedholm's study (2006) showed students in the virtual environment who spent (on average) less time working on the course still understood basic concepts as well as their peers in the face-to-face course. Online students however, earned significantly lower scores on questions requiring application of concepts and a deeper understanding of the material. These results suggest spending more time on the task leads to deeper learning .Designing online courses that take advantage of student motivation could increase the amount of time online students spend studying course materials and in turn promote deeper understanding of concepts and improve student ability to apply information learned to real-life problem solving situations.

Similarly, Tuladhar&Parajuli (2020) studied entitled "Study on the effectiveness of virtual classes for undergraduate medical and dental students of Gandaki Medical College during COVID 19 pandemic period in Nepal"

Pandemic situation of COVID 19 had an impact on medical education globally leading to cancellation of lectures, laboratory exercises, clinical postings and exams. To continue with the academic program, the online classes are started in different academic streams in large scale. This came with challenges and new learning opportunities for medical students and potential to adopt some changes. The objective of this study is to find out the effectiveness of online classes for medical and dental students of Gandaki Medical College (GMC) during COVID 19 pandemic period in Nepal with questionnaire based survey distributed to the students attending the online classes.

This is a descriptive cross sectional questionnaire based online survey. The questionnaires were distributed to the undergraduate medical and dental students of GMC, Pokhara, Nepal.

Amongst the students who responded, majority 205(98.1%) were attending online classes. The device used by most of the students to attend the classes was smart phone 156(74.6%). The strength of internet of the students was good in 41 (19.6%) and satisfactory in 99 (47.40%). The internet was disturbed by electricity cut down as responded by 66(31.6%) students. Almost 140(67%) of the respondents rated the online classes were interactive and 124(59.33%) rated the classes were not disturbing. Despite the classes being interactive and non-disturbing, 162(77.51%) of respondents rated that the online classes were not effective. The online classes with one to 51 number of students showed good interactions as compared to classes with 51 to 100 number of students (p<0.01). There were no differences seen in the effectiveness in online classes between these medical and dental students (p=0.414).

Good numbers of students had participated in online classes in medical and dental streams at GMC. The students faced problems in internet connectivity due to electricity cut down. The online classes were not that effective as class room classes. In country like Nepal, various factors affecting the online education should be looked upon to make the online learning effective.

In addition, Fish and Kang (2014) compare outcome data from 119 students divided between virtual class and face-to-face sections of a stress management course and find no significant differences between delivery formats in the students' average score on three exams given during the term. However, the authors find that students who took the course in the online format earned higher scores on the final exam and that the difference is statistically significant. One section was taught in a face-to-face format, and the other was offered completely online. Both courses were taught over a 10-week period and featured the same instructor and consisted of identical assignments.

The sample sizes for each section are fairly similar—56 students in the online section and 63 in the face-to-face section. In terms of additional similarities between the two course formats, the lectures, exams, and course requirements consisted of the same content and instructions. However, online students viewed and/or listened to recorded lectures, whereas face-to-face students listened to live lectures offered twice a week (with each session lasting for approximately 100 minutes). Face-to-face students also had opportunities to discuss questions in small groups and somewhat modify the substance of the lecture through in-class questions. Because attendance

was counted as part of a student's grade in the face-to-face format, students in that section were incentivized to attend class. Finally, exams in the face-to-face section were administered in a proctored, in-class environment, while exams in the online version were offered via Blackboard in an un-proctored environment with various limitations (which included timing, randomization of questions, and inflexibility with regard to question order).

Using a t-test, the authors find that no significant differences in exam scores between the delivery formats when all three exams given throughout the term were examined together. However, in analyzing exams one-by-one, Fish and Kang found that there was a statistically significant difference among scores for the third exam—in favor of the online format. Moreover, older students (particularly on the second exam) scored lower than younger students, and Latino students scored lower than Caucasian students. It may be useful to note that the exam scores were one of several dependent variables that the authors analyzed in their study, although the others were largely self-reported (on the part of students) and significantly less objective.

To their credit, Fish and Kang analyze the impact of various delivery formats in a nontraditional course that may present difficulties in evaluating student outcomes that are somewhat different from those well documented in the literature on more "traditional courses. However, there exist some methodological flaws in their research design that are worth pointing out. First, the authors fail to contend with two forms of sample selection bias. On a broader level, they acknowledge that the students who took the stress management course during the semester of interest did so voluntarily and under the knowledge that they were participating in a study. Therefore, there may have been a non-random group of students that chose not to take the course as a result of not wishing to participate in a study. Furthermore, the students themselves self-selected into each delivery format, as the authors are unable to randomize students into particular sections. Moreover, Fish and Kang admit that the sample sizes from which they draw their results are quite small.

While it is understandable that the sources of selection bias might come from factors outside of the researchers' direct control (e.g., having to attain full Institutional Review Board approval), the authors could have done more to control for variables correlated with student outcomes and delivery format. For example, the authors observe that students in the online course were slightly older than their counterparts in

the face-to-face section. This distinction—when unaccounted for—may be particularly dangerous in this setting, as age would appear to be particularly correlated with the subject matter of this course (stress management). While the authors do present summary statistics associated on how exam grades vary across students with different characteristics, it would have been far more valuable to incorporate these characteristics as covariates in a multivariate regression of student outcomes on delivery format.

Hence, the virtual and face-to-face sections are not completely standardized, which means that the measures of student performance associated with each section may have been driven not so much by the format of the course delivery as by additional factors unique to each section. For example, exams in the face-to-face section were administered in a proctored, in-class environment, whereas exams in the online section were given online in an un-proctored setting. While the authors try to ensure that these environments are as standardized as possible, there may still have been some significant differences that impacted the validity of the evaluation. Furthermore, participation in the face-to-face course was counted as part of the course grade, while Fish and Kang do not give evidence that a similar grading structure was implemented in the online section. As a result, students in the face-to-face course may have been more incentivized to "attend" lectures, thereby inflating the exposure they had to instruction (relative to the students in the online course) that thus provided potentially positive effects for their performance. The authors also state that the online learning model used in this course was relatively "bare-bones," and without much "multimedia, discussion boards, or videos." This may provide limitations to the external validity of this study, particularly in settings where the online courses are developed with more sophistication.

Mulenga (2020) present a dissertation entitled "Is COVID-19 the Gateway for Virtual Learning in Mathematics Education?" virtual 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 secondary school teachers. Data was collected from 102 prospective mathematics teachers from the Copperbelt University (CBU). Cluster analysis approach was used. Results revealed

that participants' scores for digital learning in mathematics in cluster 2 were higher than those in both cluster 1 and 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 in relation to mathematics pedagogy during the COVID-19 crisis. Results show different patterns. However, overall results show that digital learning could be a positive response to COVID-19 closure period.

Likewise, Dahal&Dahal (2015) conduct the study entitled "Opportunities and challenges to use ICT in Nepalese Mathematics Classroom" ICTs provide great opportunity for schools/universities in developing countries (Like our) 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 facilities that form the basis for the establishment of e-learning. It argued that, schools/universities in developing countries should adopt e-learning technologies to improve teaching and learning processes. Pedagogical, technical and cost issues should be taken into account for each specific technology when integrating ICTs in teaching and learning practices as challenges. Therefore, before implementing the ICT familiar curriculum in school to university level, the Ministry of Education Nepal, Curriculum Development Centre and other related sectors need to think for removing the challenges that we are facing. We think at first the Ministry of Education need to make and implement the suitable policies, aware programs, training programs etc. related to ICT and also local educational sectors are also require to actively involve for develop and implement the ICT familiar curriculum in each educational level.
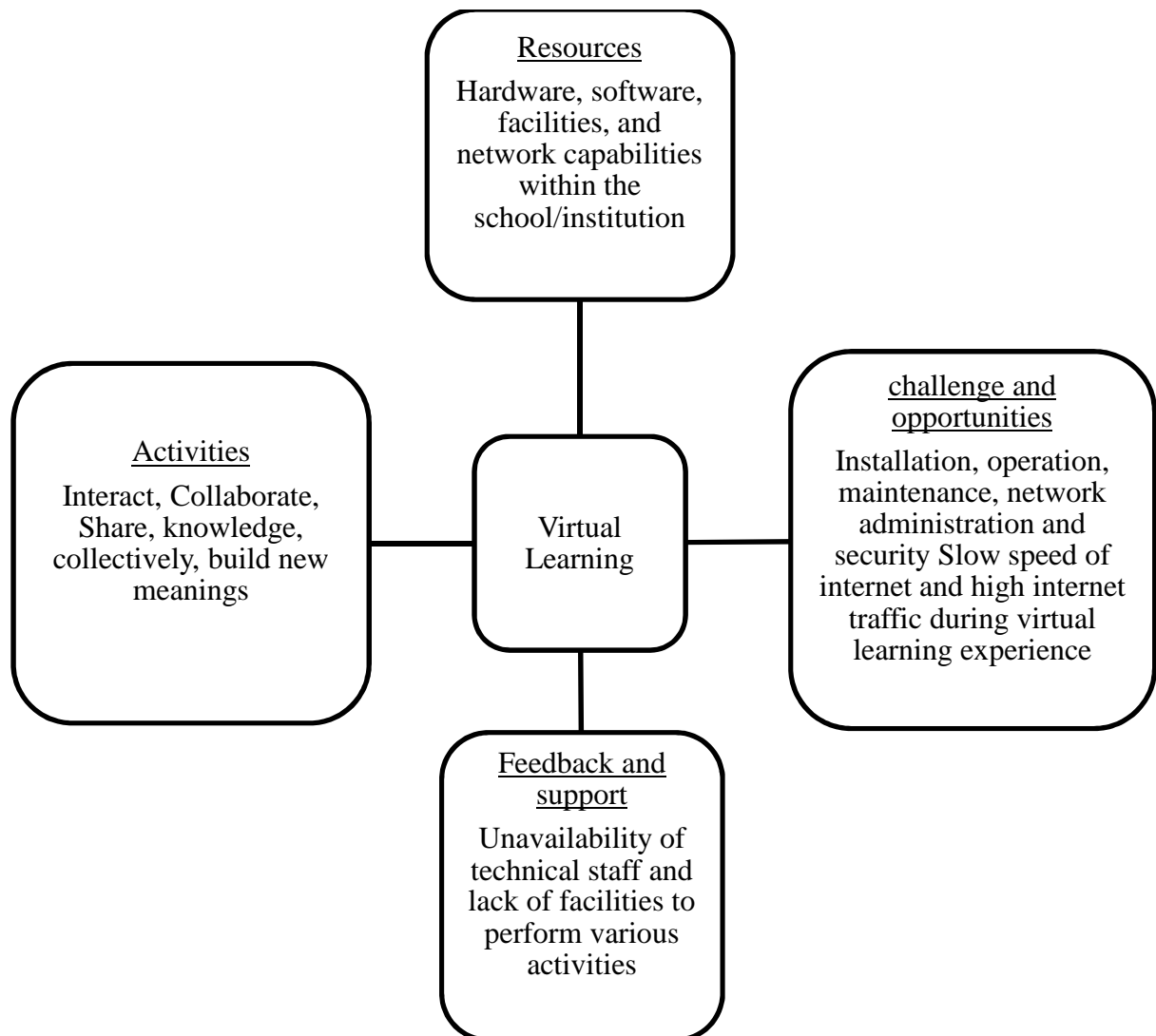
Nowadays, virtual Learning turns out to be more and more practiced. Many traditional schools started to share their courses virtual for free. It represents an easy and comfortable method to achieve knowledge in almost every field. Virtual learning is a great alternative to traditional schools, especially for people who can't afford the time and money to take real courses. Virtual learning is not just a change of technology. It is part of a redefinition of how we as a species transmit knowledge, skills, and values to younger generations of workers and students. Learners will have access to millions or billions of knowledge modules. Some will be Web pages with simple text and graphics. Others may include multimedia simulations. In many fields,

Virtual learning has become the default way to conduct training or to provide education. Virtual learning has revolutionized learning in the workplace for a number of years, improving efficiencies, workflow and collaboration. The flexibility offered by Virtual learning in terms of place of learning and time of learning means that whole education programmers can be rolled out across teams all over the world. Within the education sector, Virtual learning has been used within classrooms, from primary to university education, to deliver impactful courses that are fun and engaging. As with most teaching methods, Virtual learning also has its own set of positives and negatives. Decoding and understanding these positives and negatives will help institutes in creating strategies for more efficiently delivering the lessons, ensuring an uninterrupted learning journey for students.

The main knowledge of this literature review is that Virtual learning is perceived to be useful. Virtual learning is the need of the present and future especially in developing countries like Nepal. It is efficient, time saving and cost effective in the long run. The opportunity to study from anywhere in the world becomes an advantage of Virtual learning which, is not possible in traditional face-to-face learning. There is no boundary of time schedule and building. Virtual learning provides opportunity to contact any teacher or institution from any part of the world. Virtual Learning has a lot of benefits which inspire its use and also encourage the search for ways to reduce disadvantages. Virtual learning is a global trading of learning method. Nepal has also started to use Virtual learning. But attitude, opportunities and challenges of student towards Virtual learning in Nepal has not been yet explored. This research gap is seen. Therefore, this study explore secondary level student attitude towards Virtual learning.

Conceptual framework

  Conceptual framework can act like a map that takes different forms depending upon the research problems. A conceptual framework is the representation of the main relation of the research. This study is related to virtual learning during pandemic situation in mathematics education. The following conceptual framework is constructed.

Resources
Hardware, software, facilities, and network capabilities within the school/institution

Activities
Interact, Collaborate, Share, knowledge, collectively, build new meanings

Virtual Learning

challenge and opportunities
Installation, operation, maintenance, network administration and security Slow speed of internet and high internet traffic during virtual learning experience

Feedback and support
Unavailability of technical staff and lack of facilities to perform various activities

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Chapter-III

Methods & Procedures

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The research will be adopted for the following methodological procedures to achieve the objective of the study. This chapter consists the research design of the study, area of study, selection of respondent, data collection tools and techniques, data collection procedure, data analysis procedure and ethical consideration.

Research Design

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

Research design is the plan and procedure for the research (Creswell, 2008). This study was based on case study which is the type of qualitative research. Case study research is an investigation and analysis of a single or collective case, intended to capture the complexity of the object of study (Stake, 1995). A comprehensive of a social unit-be that unit person, a group, a social institution, a district or a community is called a case study (Khanal, 2074). The purpose of case study research is to generate clear, systematic and precise descriptions of the meaning of experience. I want to gain concrete, contextual, in-depth knowledge about specific real world of this study. The major concerned of my study was to explore secondary level students' attitude on virtual learning in mathematics education and opportunities and challenging of virtual learning in mathematics education. So, for achieving this purpose, I used case study research design because in case study researches design.The data is collected through direct observation in natural setting.

Area of the Study

The area of this study was based on secondary level students under UjjwalShishuNiketan of Kathmandu valley during academic year 2077/2078. I want to research about the students' attitude towards virtual learning and the challenging and opportunities of virtual learning during pandemic situation for this the facilities relating to the virtual learning were available in my selected field. So, I chose the Kathmandu districts school for my study.

Selection of Respondents/ Participants

As the participants, I selected the mathematics teacher and students of UjjwalShishuNiketan Academy using purposive sampling technique. For the study of my research, I selected two teachers who have been teaching mathematics subject and six students from the sampled school for my research based on the conceptual framework. I used purposive sampling technique for selection of participants.

Data Collection Tools

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

Interview. An interview is essential structured conversation where one participant asks question and the other provides answers. Interviews usually take place face to face. It is the process of data collection from face to face with interaction. Interview is a two-way interaction between interviewer and interviewee. An interviewer creates situations that can attract the attention of respondents for an enough period of time in asking questions and answering the questions, in which the interviewee puts his/her understanding and meaning (Khanal, 2073). This is also one of the major data collection tools which provide basic and personal information towards research. The interview supports the qualitative data to make a valid research. I developed the different interview schedule form for students' interview and for mathematics teachers' interview. I took in-depth interview with mathematics teachers and students using open ended questions and unstructured questions. Interviews help in communication with the students through face to face and also to get information about the personal gestures, habits, attitudes of the students. Also, it is helpful to understand the personal thoughts, ideas and experiences of the students.

Observation Form. Observation note was used to identify the attitude, challenges and opportunities of virtual learning in mathematics educations, interactions of students-students and teacher-students about virtual learning. I observed mathematics teaching/learning virtual classes, facilities, materials in the sample school.

Interview Guideline. Two forms of interview guideline were developed. One was given to learners and the other one was given to the teacher. They were structured guidelines that both were composed of open-ended format type questions. The guideline was based on Christensen and Knezek(Molina-Toro et al, 2019) instrument for assessing the impact of technology of education.

Quality Standard

After completing the construction of this research tools, it is necessary to maintain quality standard. Quality standard refers to how well a test measure and what it is purposed to measure. Quality standard of research tools are determined with the help of related theory and subject expert. To determine the quality standard of research tools, the interview took over a period of time with the selected samples. Further the purposive sample technique was adopted to maintain the trust of the study. I also ensured the internal validity by observing the same data on the basis of conceptual framework development in previous section.

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

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

Dependability. Dependability is in preference to reliability. It shows that findings are consistent and could be repeated. This is the third standard for judging qualitative standards and refers to the stability or consistency of the inquiry processes used over time. For this I took rational idea to select the people. Also, I tried to ensure credibility and transferability to maintain dependability. To maintain it, I had presented the logic used for selecting people and events to observe, interview and include in the study.

Conformability. Another quality standard for qualitative research is conformability, which refers to the quality of the results produced by an inquiry in terms of how well they are supported by informants who are involved in the study and by events that are independent of the inquiry (Khanal, 2019). So, to maintain conformability before concluding information I reviewed that information myself

several times and sometimes I conform that information to my other students/friends before concluding information as well.

Data Collection Procedure

For the collection of data, I visited a sample school which has been selected for my research and then I organized the interview schedule with related persons and visit the school also. After the preparation of my interview question, I prepared the interview schedule with related students and teachers and experts then the data was collected according to the interview schedule time. I observed the virtual class of mathematics by the permission mathematics' teacher and other related persons.

I collected the data by separately in-depth interview with the concern of related mathematics teacher and students. I used primary sources and secondary sources for data collection procedure. The primary information was collected from mathematics teacher, mathematics students and other related person and the secondary information was collected from article, reports, books newspapers and other sources. After collecting the data, the researcher interpreted and analyzed the data then found the conclusion of the study.

Data Analysis Procedure

After collection of the data from selected sample using interview guidelines and virtual class observation note and school document related to this study the researcher analyzes and interprets the data. For the purpose of analysis, the themes were analyzed for answering the research questions. Methodological triangulation will be used by gathering data by means of different data collection methods such as in-depth interviews, focus group discussions and field notes. Data triangulation was secured by using the various data sets that emerged throughout the analysis process findings (Korstgens& Moser, 2018). Mainly three types of sources will be triangulated such as attitude of students challenges opportunities, class observation and taking interview with mathematics teacher and students.

The important paraphrase with same meaning will be brought together and summarized to support the argument whereas less relevant passages with same meaning are skipped for the case analysis. Cross match, Triangulation, thick description and member check will be adopted to maintain the validity and reliability of the research study. Triangulation aims to enhance the process of qualitative

research by using multiple approaches. Methodological triangulation was used by gathering data by means of different data collection methods such as in-depth interviews, focus group discussions and field notes. Data triangulation was secured by using the various data sets that emerged throughout the analysis process findings. This study was limited into qualitative research therefore the major part of data analysis was based on descriptive analysis. The data collecting from interview and class observation was analyzed descriptively on the basis of conceptual framework. To analyze the collected data, I followed the procedure organizing the data, editing the data, coding and recoding the data, building theme, reporting and finding procedure. Firstly, I constructed different theme based on conceptual framework then I organized and edited the data and then I generated the different code according to the response of participants and also recoding the data according as similarities. After coding and recoding the data the researcher was given the title for them and reporting and finding the procedure after analyzing the collected data, researcher used the triangulation method to conclude the research.

Ethical Consideration

Ethical consideration is one of the most valuable ornaments of the researcher. All information collected about the individual will be kept confidential and private. The researcher is the only person who has access to the data after the collected observation and interview from participant. I did not mention the names of participants that are used. I used the pseudo name or code for identification of the participants and schools.

Chapter IV

Analysis And Interpretation

This chapter deals with the analysis and interpretation of the collected information using the descriptive method. This was a case study approach under the qualitative method; therefore, I had selected four mathematics students for the case study from the sample school. For the collection of information, I had used an interview, classroom observation, and document analysis as tools of data collection. The interview was taken for related mathematics teachers and students, by using an open-ended or semi-structured questionnaire. The main research questions of this study were what are the challenges do students encounterwhile taking virtual class in mathematics education? What are the opportunities that students entertain while taking virtual class in mathematics education? What are the students' attitudes on virtual learning? What is the students' perception about quality of virtual classes in mathematics education?

Also, I had observed the mathematics online classes. In class observation, each activity and behavior of the students and teachers were carefully observed and noted. Also, the responses of the respondents were carefully noted during a face-to-face interview with related persons. There was no limitation to their responses for respondents and they were able to freely express whatever they had in their mind. I had minutely studied about students' mathematics annual result and their attendance from school. The open-ended or semi-structured questionnaires of the interview schedule with mathematics teachers and students presented in Appendix. The descriptive method is mainly used in this research for analysis and interpretation of the collected data. For analysis of the data, first of all, the collected information is categorized into different themes in the text of the interview and observation notes. Thus, the collected data is analyzed and interpreted under the following headlines or sections;

Introduction of Sample School

UjjwalShishuNiketan Academy was established in 1987 AD with the genuine purpose to spread quality education to all. This is located at Sahidpath, Paga ward no. 5. The name of UjjwalShishuNiketan Academy formed with three different languages Sanskrit, Nepali and English itself describes the meaning as an educational home for

luminous children. In the school, the children can study from preprimary level to secondary level. This school is in the process of higher level and soon will start up to +2 with management and science faculty. This school is one of the oldest in Kirtipur municipality with around 1000 students and around 60 staff. This school is affiliated with PABSON and it frequency gets the PABSON top in school level examinations.

The principal of this school is DilmanMaharjan and vice principal is Ishwor Muni Bajracharya. Fee structure of school is nominal so that the local and outside students can easily study in the school. I am the secondary level math teacher so I have chosen UjjwalShishuNiketan Academyfor my studies.

Introduction of case students

This case study was conducted mainly in UjjwalShishuNiketan Academy under Kathmandu valley. The purpose of this study is to explore secondary level student's attitude on Virtual learning during pandemic situation. To analyze the opportunities and challenges of Virtual learning, this is based on virtual learning during pandemic situation.

The study conducted at the secondary level was based on special student-teacher interviews and classroom observations from sample school. A total number of five students and two teachers from school were interviewed as a sample. The following respondents were taken as sample of the study.I am writing a qualitative research study in the field of mathematics education. For ethical consideration in my research I used pseudo names for all respondents. All the participants are, of course, treated anonymously and their names are not revealed. The pseudo name is a fake name used by a writer when writing and publishing their work in order to protect them or increase the chance of success. Pseudo names are less widely used now, especially in the digital age, there are still a number of reasons why a writer may choose to use one.

Paras

Paras, a male student is from Kavre. He is 14 years old. There are six members in his family with parents and one elder brother, one younger brother and one younger sister. His parent's occupation is agriculture. His family income is not sufficient for his family. His father is literate but his mother couldn't read and write. He studied in village school in grade 5. Now he is in Kathmandu for his secondary level studies. He

studies in UjjwalShishuNiketan Academy at class9 with optional subject Mathematics.

He was unknown about virtual learning when he studied at primary level. While he came to Kathmandu for his secondary level study he was little more introduced with digital technology like YouTube, Email, Internet Computer. In the pandemic situation he has been habituated in virtual learning. He used Zoom, Google Meet, Mobile as a digital technology for taking online class and when he gets confused in any mathematical problem, he uses YouTube to solve it.

Ram

Ram, a male student is staying in one of the houses in Kirtipur, Kathmandu. He is from Kapilbastu district. He is 15 years old. There are 8 members in his family including parents, one younger sister and three younger brothers. His father is a teacher and mother is a house wife and also involves in agriculture. His family is middle class family. He is very talented in mathematics at lower secondary level and he was always stood first in his class. He came to Kathmandu from Kapilbastu for secondary level study and now he is studying in UjjwalShishuNiketan Academy, Kirtipur. So, he is one of the students who wasunknown about the use of digital technology in mathematics education. He used computer and other online software when he came to Kathmandu. Ram, the male student used mathematical software like scientific calculator, Spreadsheet, Mobile phone, computer etc. when he reached in secondary level. Now a days he is familiar with digital tools such as zoom, Google Meet which used in taking virtual class.

Deepa

Deepa, a female student is from Kailali. Sheis16 years old. She has 8 members in her family with one elder brother, one younger brother, one elder sister, two younger sisters and parents. Her parents live in Kailali and she is in Kathmandu. Her family is literate.Her father works at Nasu post in municipality and her mother is related in teaching profession. Her family is a middle class family and also literate.So her learning environment is intuitive. She studied in boarding school at class 5. After class 8 she studied in UjjwalShishuNiketan Academy, Kirtipurin secondary level. She is little more familiar with the technology for learning mathematics education. She

used digital technology mobile phone, computer, online resources (email, internet), YouTube, other mathematical software like as photomath, GeoGebra etc.

After finishing her basic level she came to Kathmandu for secondary level education. She is studying in class 10 in UjjwalShishuNiketan Academy, Kirtipur. Her position in class is very good. According to her classmates, she is a talented student in class. She uses Zoom, Google Meet, and Mobile as a digital technology for taking online class.

Maya

Maya is afemale student is from Kirtipur Kathmandu. She is 14 years old and she has six members in her family. Her family background is poor. Her father's occupation is Driving Hice. Her family income is not sufficient. Her family is a middle class family. She studied primary level education from UjjwalShishuNiketan Academy, Kirtipur. She just used normal calculator as a technology in mathematics education before pandemic time at basic level. She is studying in class 9 in the same school, UjjalShishuNiketan Academy, Kirtipur. Her position in class is good. According to her classmate,she is middle level student in her class. She is more interested in mathematics learning. She learned about digital technology in pandemic period of corona virus. She uses Google Meet, Internet, Zoom and other digital technology during the virtual class in mathematics learning.

Introduction of case Teachers

The main objective of this study is to explore secondary level student's attitude on Virtual learning during pandemic situation and analyze the opportunities and challenges of Virtual learning. In this study, conducted in UjjalShishuNiketan Academy, Kirtipur,two math teachers from school were interviewed as a sample. The following respondents were taken as sample of math teacher of the study.

Shyam

Shyam is male maths teacher from Kathmandu district. He is a Teacher of mathematics subject at UjjalShishuNiketan Academy, Kirtipur with 4 years of teaching experience in mathematics and he studied ICT in mathematics Education during the fourth semester of M.Ed level. There are about 30 teachers in my sample school. Shyam is Math's Teacher of secondary level. He is a middle-aged man with an average built and height with a very pleasant smile. He is intelligent and a master

of his subject. This is one quality that impresses all the students. He is much disciplined but not so strict so that the students are not terrified of him. He makes Mathematics so easy for all that all students enjoy it. He is very soft spoken, kind, gentle, helping and caring. He is always ready to listen to the problems of the students patiently. He never refuses any child for help. He goes out of his ways to help students at any time. He has participated in various ICT seminars and trainings as well as presented worksheets. He also has good experience in the use of ICT and its effectiveness in online teaching mathematics.

Binod

Binod is a male maths teacher from Kailali district. He is a Teacher of mathematics subject at UjjalShishuNiketan Academy, Kirtipur with 1 year of teaching experience in mathematics and he studied ICT in mathematics Education during the fourth semester of M.Ed level. There are about 30 teachers in his sample school. Binod is optional Math's Teacher of secondary level. He is 25 years old with an average built and height with a very pleasant smile. He is intelligent and a master of his subject. This is one quality that impresses all the students. He is much disciplined but not so strict so that the students are not terrified of him. He makes Mathematics so easy for all of us that of us that we all enjoy it. He is very soft spoken, kind, gentle, helping and caring. He is always ready to listen patiently to the problems of the students. He never refuses any child for help. He goes out of his ways to help students. He has participated in various ICT seminars and trainings as well as presented worksheets. He also has good experience in the use of ICT and its effectiveness in online teaching mathematics.

Online Class Learning Environment.

Good environment is important factor for good learning. Virtual class environment should be educational, practicable and peaceful for study. For good learning of students, school environment should be mixture of social value, culture and education, friendly behaves, safety practice and organized structure and physical infrastructure and access of internet is the most important for the use of digital technology. The relationship among administration, teachers, students, parents is also responsible for good learning school environment for students. There should be healthy relationship among teachers, students and parents. And for the healthy

competition between students for the virtual learning in mathematics education the school environment must be students friendly and digital infrastructure is main factor for it.

The school environment plays an important role to decide the future position of students and their lives. The teaching activities and extra curriculum activities conducted in the school come within the school environment. There should be rules and regulations to be followed by teachers and students to build their bright career. I have observed many mathematics classes of grade 9 and 10 However, due to the slowness of the net and lack of network connection, it seemed that the students had difficulty in accessing the services through the net.

Classroom Observation

This is the qualitative research so online classes' observation is the most important data collection tool with interview for the research. To find the students participation & activities in the class about the virtual learning, the researcher observed 10 classes of sample school and observed the class activities carefully. As a part of research, the researcher observed respondent students in the online classes of grade 9 and 10. The classroom activities were observed according as the observation form prepared by the researcher himself consulting with supervisor .Among them 10 class observation finding is presented in the following two episode:

Episode 1

This class observation episode was related to class 9 of UjjwalShishuNiketan Academy, Kirtipur. There were 30 students in the class, among them 18 were boys and 12 were girls. There were 28 students present in class where 17 boys and 11 girls. They were scattered randomly in the class. The teacher as usual entered in the class with a greeting and the students responded him most of time he revised previous lesson before he started the new lesson. This is the class of algebra. The teacher equally responds the curiosity made by the students. The involvement of students in teaching learning activities was satisfactory. Many of the student reported the same factors as poor internet connectivity, unstable power supply, notification distraction, security and privacy, awareness about the benefits of e-learning, resistance from students and educators to using virtual learning methods, lack of technical knowledge, shortage of gadgets, lack of quality e-content, lack of awareness, lack of foreign

language skill, incompatibility of contents, high rate of illiteracy in computer and skill unavailability, attitudinal hampering, cultural barriers are the main challenges of virtual learning. These are the main challenges of virtual learning while student taking virtual class in my sample school.

It was the third observation class of the sample school. Most mathematical subjects are related to abstract knowledge and one subject related to abstract knowledge is algebra. Abstract subjects are easier to understand if taught using mathematical software's Geogebra, Mathematica.

The researcher observed that algebra was being taught in the class. Students were taught through discussion using a student-centered method However; it was clear from the class that it could be difficult for students to understand just by using discussing the theory. The students were interested in the understood subject but in the abstract subject the students were only writing rather than reading carefully. Thus, despite the use of student-centered teaching methods, there was a lack of reliable net and voice disturbance in teaching and learning.

Episode 2

This class observation episode was related to 9 of UjjwalShishuNiketan Academy, Kirtipur There were 23 students in the class, among them 12 were boys and 11 were girls. There were 21 students present in class where 10 boys and 11 girls. It was second class observation of this class and it was in morning. All the students said "Good morning." then the teacher repliedthem good morning and welcomed to math class. This showed that the students were well disciplined and the school had taught them to respect the teacher. The class was well managed. The involvement of students in teaching learning activities was satisfactory because the interaction between teacher and students has been getting well. But the students were not ready to open camera but the teachers forced them to open camera.

Firstly, he reviewed the previous lesson of simplification then wrote a problem from the textbook and solved the problem on the online whiteboard by explaining step by step. After one demonstration, again the teacher had taken another problem from the textbook, and also, he had solved this problem using the problem-solving method. It seems that the teacher does not provide the opportunities for the students' problems and the teacher teaches the mathematical problem based on equality approach rather

than equity approach. Overall, the teacher used the problem-solving method, and only sometimes he used the discussion method in the mathematics classroom.

The above virtual class observation indicates that there is a lack of active participation of students in the mathematics classroom. From class observation episode, it can be concluded that most of the students were weak in mathematics, and also students had no interest in learning mathematics that may be because teachers do not give opportunities and do not motivate students in the mathematics class. Thus, from the above observation it can be claimed that there was no active participation and discussion between students-students and student-teacher in the mathematics class.

On class observation time, it could be seen that there was no proper interaction between teacher and students. And also, the teacher did not use the student center learning method in the virtual class. The teacher mostly used only the lecture method in the class and sometimes he used the problem-solving method but that method was not sufficient. During classroom observation time, it could be seen that teacher had not used any ICT-related materials/software (PowerPoint, GeoGebra, Mathematica, etc.) in the class. The teacher mostly used only the problem-solving method and lecture method in the virtual class. But only this method was not sufficient for effecting teaching content. The integration of technology in teaching and learning mathematics helps in creating collaborative teams and working groups to help each other among the teachers and students as a part of teacher professional development (Trigueros& Lozano, 2012).

View of respondent students

Respondent A. The name of respondent A is Paras male student from Kavre. He is 14 years old. He was a student studying in grade 9 at UjjwalShishuNiketan Academy. According to him, he could not solve all the mathematical problems any time because no one guided him in a study at home. During the observation period, I saw that he was a poor student for mathematics learning. He does participate in extracurricular activities held by the school. According to her, mathematics subject was not the favorite subject. He takes mathematics as hard for him because he can't give enough time for learning mathematics at home.

During the interview time, I had asked the question according to interview guideline he replied,

> *"First of all I clearly say that I don't know what is zoom and what google meet is so those are the very new for me. So I faced many difficulties to use this application and firstly I don't know how to join virtual class, how to share screen, how to raise hand and use other different tools. At that time I was at home, I faced so many problems.Sometimes I faced problem of reliable net, environment, electricity, loud sound, and teacher unable to connect me in class, such kind of problem a faced and I did not understand clear concept about the mathematics in virtual class . I have not proper knowledge about the ms team at that time I use the YouTube for knowing about the google meet and zoom. Those are my barriers while taking virtual class". I get content knowledge through the virtual classes, in pandemic time I meet my friends and professors virtually and sharing the knowledge and ideas. Our courses are completed in the time through the online classes that is the opportunities if virtual classes was not conducted in time it may be so late for the final examination. Overarching themes of "independence" and "motivation" as important characteristics that the virtual class brings out in students who wish to be successful. In the future i do not want to take online classes because i feel so uncomfortable in online.*

Respondent B. The name of respondent B is Ram, a male student is staying in one of the houses in Kirtipur Kathmandu. He is from Kapilbastu districts. He is 15 years old. He was a student studying in class 9 of UjjalShishuNiketan Academy, kirtipur.In the observation period, I saw that he was active and energetic in the class. He does cross-question in the class. He wants to be more extra than other students in the class. He likes the cooperative teaching method in the class because he wants to learn mathematical problems connected with our daily life. He always participates in extracurricular activities held by school but his family background was not good. He takes a mathematics subject as hard for him because he can't give enough time to learn mathematics. During the interview time, I had asked the question according to interview guideline he replied:

> *"From my point of view, the school provides us zoom id for virtual learning. But I faced many difficulties to use this application and firstly I don't know*

how to share screen, how to raise hand and use other different tools.*At that time I was at home, I faced so many problems sometimes I faced problem of reliable net, environment, electricity, loud sound, and teacher unable to connect me in class, such kind of problem a faced and I did not understand clear concept about the mathematics in online class . I have not proper knowledge about the zoom at that time i use the YouTube for knowing about the google meet and zoom. Those are my barriers while taking online class". I miss the interaction with people, making long-lasting friendships, which is extremely important for me during school time. My technical, communication skills improve by the virtual classes that is the great opportunities for me. I habitual with e-mail communication helping us our professor, online classes help to us for finishing our course in time. These contacts are very valuable in business later and it is absolutely necessary to build those. But virtual class getting me opportunities to communicate with my colleagues.I do think that education could be continued to function like this in the future, according to my experience. I think that universities could transfer some lectures to the online format. After taking this course I am habitual to visualize the mathematical problem because there were effective learning activities in classroom and I get learning and sharing culture. As a whole I can confidently say that online class can develop learning ability".*

Respondent C. Deepa is a female student from Kailali. She is 16 years old. She is a student studying in class 10 ofUjjwalShishuNiketan Academy, Kirtipur. She has 8 members in her family with one elder brother, one younger brother, one elder sister, two younger sisters and parents. Her parents live in Kailali and she is in Kathmandu. During the interview time, I had asked the question according to interview guideline she replied:

"Yeah, I faced so many barriers while taking online class firstly I did not know how to join the online class after that with the help of YouTube I got knowledge about the MS team and zoom. In the class time I feel so uncomfortable.Firstly, I don't know how to share screen and using other technical tool. I faced main problem related to the internet. This is all without mentioning that online learning faces many practical barriers, like internet problems, background sound, and difficulty with focus, at a scale that

traditional learning does not. All this could easily impede a student or teacher's ability to get the most out of the education experience. But I think I got many more opportunities from the online class now. I am very good in technical skill as well as ICT skill. In the pandemic time I got opportunities to interact with my friends and professors.ICT is a means of new technology which can upgrade the student's practical knowledge and technology skills. Our online is so effective from where we have able to build our logical reasoning, verbal ability and communication skills and the online includes a discussion board feature that the students are required to post their own response to a question, as well as comment on one of their classmates' initial responses to the question. In future, I want to take online classes because it saves our time and we can easily do other professional job.

Respondent D. Maya, a female student is from Kirtipur Kathmandu. She is 14 years old and she has six members in her family. Her family background is poor. Her parent's occupation is Driving Hiace. Her family income is not sufficient. Her family is middle class family. She studied class 10 of UjjwalShishuNiketan Academy, Kirtipur. During classroom observation time, I saw that she was always sitting on the first bench and making noise with his friends. She seemed always active in the classroom. She did not have his own interest in learning mathematics. During the interview time, I had asked the question according to interview guideline he replied:

"I am generally good with ICT skills; therefore it was very helpful for me to receive clear instructions on what to do. The teacher knows how to use the different tools accordingly and the classes were, therefore, interactive and pleasant to attend. I did not face any type of technical problem but I faced the problem related to the better understanding mathematical concept. I feel disturbed from my friend who did not know how to take online class effectively. Those are my barriers while taking online class. "I did not find it hard to follow the lectures and participate in group projects, etc. Thus, I would assess this experience as helpful, in terms of having an idea of how to organize my work with people who are not physically close to me. I believe that distance learning can really help us gain the skill to freely adjust to change. I think this pandemic will totally transform education. Most of the

things we found to be impossible have now proven to be possible. That is great opportunity for us. Hopefully, in the future, when a student cannot attend a class, write an exam, or present his/her thesis, we will give them an equal opportunity to do so, using what we have learnt in time of this pandemic, we habitual with e-mail communication helping us our professor. Going forward, I see a rise in online education that can increase efficiency and expand outreach. I think I am over-productive. I haven't had any time off since the lock-down. As a double degree student, the requirements are really high and there are so many deadlines to meet so I have no choice than to be productive. I think my productivity has improved with the switch to online learning. I don't have to spend time driving to university or in traffic. I can rather use that time to read an article, conduct an interview for my thesis or business project. I find the experience helpful. It could benefit me in the future in the sense that I now perceive university or work as a mindset and not a place. Those are my opportunities".

The most frequent challenges respondents noted was the lack of reliable internet at home. Four of the respondents did not have access to the internet at home while enrolled in the virtual class. Time management was the most mentioned characteristic. The most common response when analyzing the difference between traditional classrooms versus a virtual course was the feeling of less interaction and an increased need for independence in the virtual learning environment. The majority of students acknowledged the use of e-mail as a communication tool available during the class. From the students response the virtual classes in mathematics education is good but they faced many types of challenges when they adjusting in virtual classes. After taking virtual class they were habitual with online classes now they feel comfortable. Majority of student's respondents unanimously answered that they would take an online course in the future, regardless of the challenges that they may have experienced

View of respondent Teacher

Respondent E. Shyam is male math teacher from Kathmandu district. He is a Teacher of mathematics subject at UjjwalShishuNiketan Academy, Kirtipur with 4 years of

teaching experience in mathematics. During the interview time, I had asked the question according to interview guideline he replied:

> "*I am generally good with ICT skills; therefore it was very helpful for me to receive clear instructions on what to do while teaching through virtual class. I am already familiar with zoom, Google meet and MS Teem I did not face any type of technical problem. But I think that virtual learning will never fully replace face-to-face or classroom learning. In comparison to face to face learning where the number of students is limited, virtual learning allows you to share your teaching class with as many students you need. Virtual learning has its benefits as students can learn from the comfort of their home. As teachers, they prefer when their students to be in front of them, so they give them immediate answers; teachers remember their students' faces and their capacity of learning. Virtual teaching and learning becomes successful when students accomplish their requirements successfully. When students show good learning abilities and give positive results that is when learning becomes successful. Given tasks, homework, quizzes, tests, all these are proof of students' work and commitment to a subject. When virtual, students can get more data in the moment and be prepared, but they can also use Internet as a cheating method which is something negative for e.g. having another person behind the camera, while having an exam, they have experienced this kind of cheating, and the student got the highest mark. In this pandemic situation virtual class help to grow student's capacity*"

Respondent F. Binod is male math teacher from Kailali district. He is a Teacher of mathematics subject at UjjwalShishuNiketan Academy, Kirtipur with 1 years of teaching experience in mathematics and he studied ICT in mathematics Education during the fourth semester of M. Ed level. There are about 30 teachers in my sample school. Binod is optional Math's Teacher of secondary level. During the interview time, I had asked the question according to interview guideline he replied:

> "*Virtual learning creates access to lots of resources for teachers and students of all over the world. By using a good and useful platform of virtual learning, it provides or delivers a very rich learning pathway. Virtual teaching can be provided by a lot of platforms or other resources such as: ZOOM, Google meet, Google Classroom, slide share, video maker platform, etc. They also claim that the best activity for virtual teaching is discussion about the topic*

including questions from students about unclear notions. Nevertheless, ZOOM is the most useful tool which has helped the teaching and learning process to progress throughout COVID-19.Normally assessed the students by asking for students' recordings and sent a voice recording to them, sometimes they sent pictures of their work, and this way I assessed them and their work. For ZOOM to be effective, you really need a stable Wi-Fi. Without that, the sound is not stable; students and teachers will hear an echo and repeat themselves. Regarding teachers' schedule, the class duration was 20 minutes maximum, so teachers think there was not enough discussion about topics, just going straight forward to aims. Therefore, according to these kinds of problems teachers could not say that the discussions were effective enough. I faced lots of shy students who escape from conversations or from the given duties. I discovered that the best solution for this is to do more group games (using games that they like the most) and try to make these shy students group leaders. Also a good method to motivate them get encouraged is to praise them all the time by saying that they are doing very well even if they not actually. According to these points, teachers have noticed an improvement of these students. I prefer when the students to be in front of me, so i give them immediate answers; i remember the students' faces and their capacity of learning. Finally in this lockdown period online class provides the great opportunities to students/learner".

Overall, in this investigation, secondary mathematics teachershave faced a great challenge in using virtual learning as a tool of instruction during school closures as a result of the COVID-19 pandemic. Their most significant challenges were at the student level including student lack of knowledge and skill in virtual learning use, and their lack of access to devices and internet connection. Student barriers had a strong correlation with the barrier at the school level. This study expands the existing studies relating the virtual learning use in secondary schools, particularly in aspect of barriers to virtual learning use during the time of a pandemic. And this pandemic situation provides us great opportunities as well students learn many things from the home and they learned many ICT based skill. From the virtual class students got many benefits and opportunities like, improve technical skill, learning by visualize method, time saving, improve communication skill, students learn many more thing from virtual. Students habitual with e-mail communication helping us teacher, online classes help for finishing course in time.

The Opportunities and Challenges of Virtual learning during pandemic situation.

The researcher used interview and observation to collect data from respondents on virtual learning opportunities and challenges. In which the virtual learning opportunities from the first question and the challenges of virtual learning from the second question were collected. The researcher has collected the answer from the open-ended question by considering the double and the same answer as one and removing the irrelevant answer and summarized them and explained them.

Opportunities of Virtual learning

To investigate the factors of online class to be positive the researcher used interview guidelines which were given in Appendix. In this section i asked many questions according to interview guideline related to the opportunities of virtual class in mathematics education during pandemic situation.

> *One of the respondents said that, "From the virtual* class *I got many benefits and opportunities like, improve technical skill, learning* by *visualized method, time saving, improve communication skill, I learn many more thing from online class I feel more comfortable than physical class and my technical and communication skills improve by the online classes that is the great opportunities for me. i habitual with e-mail communication helping us our professor, online classes help to us for finishing our course in time and especially online class getting me opportunities to communicate with my colleagues. I can confidently say that online class can develop learning ability".*

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

Self-Learning

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

Student-centered learning (SCL), also referred to as learner-centered education, is a modern learning method which aims to put the students in the center of focus, rather than the teachers. Online learning is fundamentally student-centered, due to the easy implementation of student discussion boards and peer grading systems. Self-learning is a process by which individuals take the initiative, with or without the assistance of others, in diagnosing their learning needs, formulating learning goals, identifying human and material resources for learning, and evaluating learning outcomes (Knowles, 1975). According to James Thomas, A self-paced system enables them to make progress with rhythm that suits them. This type of system does not require attending live sessions; you can access the materials at any time that works for you. That's an advantage the traditional educational system cannot beat (Thomes, 2019. The research has demonstrated that self-paced learning leads to increased student satisfaction and reduced stress, resulting in improved learning outcomes for everyone involved. Some of the advantages of self-paced learning include efficiency, effectiveness, convenience, scalability, and reusability (Masie, 2019).

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

Flexibility

Flexible learning provides students with full control and accountability for their learning. With the help of virtual learning, the students can take lessons online in flexible hours. They can learn at their own convenience anytime, anywhere sitting at any place. The students can be trained from all the countries, places whether in the remote areas or countryside areas where education facilities are not available. Students who study online can plan their own time schedule, without having to make personal sacrifices in order to meet the class attendance requirements of teachers and traditional universities.

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

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

Virtual learning is cost-effective

Virtual learning can naturally be much more cost-effective than classroom-based learning, as it does not require learners to travel to be in the same place, or invest in special equipment and learning resources for each module of their course. Instead, Student can log into a portal, like Virtual school Learning Management System Enable, from wherever they are, automatically removing travel expenses. As modules can be studied for via the screen, it also removes the need for people to spend on textbooks or other specialist equipment.

From the response of students and teacher Cost-effective is a main feature or facility of virtual learning. Student mainly included travel and accommodation, meal costs, classroom maintenance, text books, printed learning materials, and salaries for teachers and other staff. Virtual learning is cost effective as compared to traditional forms of learning. The reason for this price reduction is because learning through this mode happens quickly and easily. Can get education from anywhere at any time and mostly beneficial for financially struggling students (Thapa, 2020).

Many of the student reported the same factors flexible, resources are available from anywhere and at any time, no any boundaries, simpler, easier, scalable, and more effective, self-study, save time, creativity, user-friendly, enhance knowledge, get international degree, quality education, skill base learning, student-centered learning, cost effective, availability, accessibility, effective use of information and communication technologies, personalized learning, improved collaboration and interactivity. Virtual learning has completely transformed the way in which learning is imparted to students. The student has said a lot about the virtual learning opportunity.

In this era, learners can flexibly choose the most appropriate learning mode in accordance with their preferences or commitments, or both. Virtual learning is a tool that enhances active and independent learning. It gives the facilities to students to take classes online at any time at any place. So, the students take the time out from their daily schedules for devoting the time to their studies. With online learning location is no longer a barrier; neither are culture and nationality. Translating and customizing your online courses to address different cultures in various languages makes possible for your virtual learning content to travel all around the world and reach the widest possible audience. The use of virtual learning also enables students to communicate,

share and work collaboratively anywhere and anytime. A number of students indicated in the questionnaire that virtual Learning has a significant role to play in supporting and enhancing their communication with their peers. Students see the use of ICT as a means of communication to share ideas and information to collaboratively construct knowledge (Singh, 2020).

Students have the opportunity to analyze problems and explore ideas as well as develop concepts. Not only they are able to acquire knowledge together, but students are also able to share diverse learning experiences to express themselves and reflect on their learning. Virtual learning makes many opportunities for education institutions, business organizations and learners. These opportunities are: effective use of information and communication technologies, delivery of educational services anywhere, anytime and to anyone, substantial cost savings, just-in-time access to timely information, personalized learning (Milovanovic, 2010).There is not much difference in the research of Virtual learning faced by the student and the finding of the previous research.

After collecting responses from all of the students and teacher, researcher has taken some representative opportunities while taking virtual class which have received a lot of response, which is Time flexibility, Location flexibility, Scope for Innovation & digital development, wide availability of courses & content, immediate feedback, with no boundaries, self-learning and Virtual learning is cost-effective are the opportunities while students taking virtual class of mathematics education

Challenges of Virtual Learning

This section covers the extracted themes that were derived from the analyses of data; each theme a converses challenge related to virtual learning and reflects the perspectives of students regarding virtual learning and their experience using virtual learning tools. The second open-ended question is "What are the challenges you face while using virtual learning?". These are the challenges for the student to know and understand about virtual learning in this question.

Challenges-related open-ended question asked to four students and two teachers. After collecting the response from all the students and teacher, researcher has taken some representative topics which have received a lot of response. Which is unstable network, lack of Motivation, lack of technical knowledge, notification

distraction and useless notification, shortage of devices, unnecessary advertisement, complexity, expensive, security.

Unstable Network and Internet connectivity

Main challenges faced by students while using the virtual learning method are unstable network and unstable internet connectivity. Responded on unstable internet, expensive internet and expensive data charges most of the students are facing these issues while attending virtual class at lockdown period. Nepal is developing country; every student doesn't have wifi connectivity. Most of the students use mobile data for their online classes so it is expensive and unstable due to which students cannot continue their virtual classes.

According to Vijay Thapa, Most of the people live in rural areas and Nepal has a difficult geographic condition which results in poor or no internet connection (Thapa, 2020).Internet is expensive, limited geographical coverage, and unstable if there is connectivity. According to respondents, internet package in Nepal is comparatively expensive which discourages students to search reading materials through the internet. Power supply, though it is more stable in these days, also stresses to students as well as instructors. According to respondents, internet package in Nepal is comparatively expensive which discourages students to search reading materials through the internet. Power supply, though it is more stable in these days, also stresses to students. The students discomfort in online class because of late joining the class, disconnect and reconnect the classes frequently. This could be because of the poor strength of the internet.

Lack of Motivation

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

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

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

Lack of Technical knowledge

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

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

Ndzibah and Ofori remind them that technical competence or incompetence is something that should be taken into consideration while planning online courses (Ndzibah&Ofori, 2017).

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

According to Shakya, Sharma and Thapa, over the past of decades, students were facing more challenges by the increasingly global, digital and dynamic environment. All the challenges like cost, language, lack of human resources, lack of ICT tools etc inhibited the growth of virtual learning. Virtual learning is being widely adopted and used in developed areas; there is the ease of accessing to get information however there is no easy access to get information for students living in developing areas. So there is a challenge of providing the infrastructure of learning taking account of internet connectivity and making the availability of virtual learning materials (Shakya, Sharma, &Thapa, 2017).

Among challenges to virtual learning, the most frequently encountered were difficulty adjusting learning styles, having to perform responsibilities at home, and poor communication or lack of clear directions from educator. Lack of physical space conducive for studying and mental health difficulties were also common. The data showed that the availability of fast and reliable internet connection was a bigger concern than either device ownership or technical aptitude. Many of the students join their classes through their mobile phones which may not fulfill all the teaching objectives like presentations. The virtual learning methods currently practiced in education tend to make participating students undergo contemplation, remoteness and a lack of interaction. As a result, many of the students and teachers who inevitably spend much of their time online can start experiencing signs of social isolation, due to the lack of human communication in their lives. Social isolation coupled with a lack

of communication often leads to several mental health issues such as heightened stress, anxiety, and negative thoughts (Thapa, 2020).

According to students' and teachers opinions after collecting the response, researcher has taken some representative challenges while taking virtual class in mathematics education which have received a lot of response. There are unstable network, lack of Motivation, lack of technical knowledge, notification distraction and useless notification, shortage of devices, unnecessary advertisement, expensive, Learner's capability & confidence level, Time Management, Distractions, frustration, anxiety & confusion, lack of personal/physical attention and complexity. The most frequent barrier respondents noted was the lack of reliable internet at home. There is not much difference in the research of virtual learning faced by the student and the finding of the previous research. But there are some new challenges in this research, they are: lack of motivation, notifications distraction, unstable network, shortage of device, security and privacy etc.

From the above interview and observation about opportunities and challenges of virtual learning in mathematics education concludes that there are many challenges and opportunities to taking virtual class in mathematics education. Response from the students shows that opportunities encounter the challenges of virtual class. Virtual learning provides great opportunity for schools in developing countries to improve their teaching and learning processes. From the student's response the virtual classes in mathematics education is positive but they faced many types of barriers when they are adjusting in online classes. After taking virtual class they were habitual with virtual classes now they feel comfortable with virtual class. Based on overall interview and observation we can conclude that students have positive attitude towards virtual class in mathematics education at secondary level.

Chapter V

Findings, Conclusion and Implications

In this chapter, I have presented the finding, conclusion and the implications of the study based on presentation, analysis and interpretation of the collected data. The followings summary, finding, conclusions and recommendation of the study have been drawn based on the analyzed data. I have presented the summary of study, findings, conclusions, and implications in the separate headings so that it will be comprehensible.

Finding of the Study

The specific objectives of the study are to explore secondary level students' attitude on virtual learning during pandemic situation and to analyze the opportunities and challenges of Virtual learning. Use of ICT in mathematics virtual class increase the interest of students, it contextualizes the content, visualize the content in mathematics education. Motivating the students is one of the challenging tasks for the teachers in Nepal, it visualizes the content so that the virtual class becomes more interactive and interesting, and it also connects the class with the international collaborative partner classes as well. Different mathematical software, You Tube videos and other internet site could help students for the conceptual learning; it refers our students for the self-learning and also connects the teachers from the worldwide in a moment.

Based on the interview results, it can be concluded that: one of the teachers thinks that virtual learning can never replace the traditional learning and face-to-face learning is more effective. Based on the research, using different methods and tools makes virtual teaching more successful because learners are prepared and they gain data rapidly. However, another teacher replied that virtual teaching is not always successful because there are cases when learners have the opportunity to cheat and get an excellent grade during the evaluation. Or, there are parents behind cameras that they do all the work instead of the child. Moreover, teachers claim that monitoring students' engagement is easier in virtual learning because teachers have the chance to teach learners in their own way using different tools such as slides, video platforms, and many other tools.

According to student's and teachers' opinions after collecting the response, researcher has taken some representative challenges while taking virtual class in mathematics education which have received a lot of response. This is unstable network, lack of Motivation, lack of technical knowledge, notification distraction and useless notification, shortage of devices, unnecessary advertisement, expensive, nets, Learner's capability & confidence level, Time Management, Distractions, frustration, anxiety & confusion, lack of personal/physical attention and complexity. The most frequent barrier respondents noted was the lack of reliable internet at home. There is not much difference in the research of virtual learning faced by the student and the finding of the previous research. But there are some new challenges in this research, they are: lack of motivation, notifications distraction, unstable network, shortage of device, security and privacy.

After collecting response from all of the students and teacher, researcher has taken some representative opportunities while taking virtual class which have received a lot of response. Which is Time flexibility, Location flexibility, Scope for Innovation & digital development, wide availability of courses & content, immediate feedback, with no boundaries, self-learning and Virtual learning is cost-effective are the opportunities while students taking virtual class of mathematics education.

Virtual learning being the most desired, effective and cheaply available tools for learner, it is more resourceful for learner as they can acquire more information accessing the internet. With the advancement of technology, many educational institutes were offering virtual learning or distance education using ICT materials. Those people who were unable to give full time for learning in an educational institute due to their own circumstances, Virtual learning has made easy learning for them by themselves using different web based technologies or seeing the tutorials in a computer or mobile on accessing the internet.

Finally from the data analysis about the virtual learning during pandemic situation in mathematics education concludes that there are many challenges and opportunities to taking virtual class in mathematics education. Response from the students shows that opportunities encounter the challenges of virtual class. Virtual learning provides great opportunity for schools in developing countries to improve their teaching and learning processes. From the students' response, the virtual classes in mathematics education is positive but they faced many types of barriers when they

are adjusting in online classes. After taking virtual class they were habitual with virtual classes now they feel comfortable with virtual class. Based on overall interview and observation we can conclude that students have positive attitude towards virtual class in mathematics education at secondary level.

Conclusion of the Study

The purpose of this study is to explore secondary level student's attitude on Virtual learning during pandemic situation and to analyze the opportunities and challenges of Virtual learning. Regarding the first research question, "To find student's attitude on virtual learning in mathematics education in the context of Nepal" and analyze the challenges and opportunities that students entertain while virtual learning in mathematics education.

The COVID-19 pandemic has triggered new ways of learning. All around the world, educational institutions are looking toward virtual learning platforms to continue with the process of educating students. Today, virtual learning has emerged as a necessary resource for students and schools all over the world. For many educational institutes, this is an entirely new way of education that they have had to adopt. Virtual learning is now applicable not just to learn academics but it also extends to learning extracurricular activities for students as well. In recent months, the demand for virtual learning has risen significantly, and it will continue doing so in the future.

The researcher found the challenges faced by students while they taking virtual class are unstable network, lack of Motivation, lack of technical knowledge, notification distraction and useless notification, shortage of devices, unnecessary advertisement, expensive, Learner's capability & confidence level, Time Management, Distractions, frustration, anxiety & confusion, lack of personal/physical attention and complexity. The most frequent barrier respondents noted was the lack of reliable internet at home. And opportunities while taking virtual class which have received a lot of response. Which is Time flexibility, Location flexibility, Scope for Innovation & digital development, wide availability of courses & content, immediate feedback, with no boundaries, self-learning and Virtual learning is cost-effective are the opportunities while students taking virtual class of mathematics education.

The study was based on secondary level student attitudes towards virtual learning in Kathmandu Valley found on the basis of opportunities and challenges faced by students. Using the interview and class observation tool, student's attitude towards virtual learning and opportunity and challenges faced by students is measured. While preparing this thesis, due to COVID-19, all colleges and schools were closed and classes were conducted online which made all parties aware of virtual learning. They are in favor of using virtual learning. Their responses show that virtual learning is needed for better learning to take place. Only a negligible number of students have negative perceptions, misconceptions, misunderstanding and illusions towards virtual learning. Overall, the students had a positive attitude towards virtual Learning. The various aspects of virtual learning tools visually, dynamic in nature help students to provide more depth understanding of quantitative techniques. The students received immediate feedback with the help of virtual learning. Students were very much impressed and excited to know about the quantitative techniques based on software. The qualitative data revealed that student were facing various problems while using virtual Learning at secondary level. They were related to devices (computers, mobile) and internet connection, their knowledge and skill, time as well as financial support, lack of infrastructure, trained instructors.

Implications of the Study

On the basis of finding of this study some measures have been implemented for virtual learning during pandemic situation in mathematics education are given below:

Virtual based teaching learning activities should be given priority in mathematics education.

The students recommended that the teachers need training on how to take virtual classes. The barriers for the virtual teaching can be minimized if the teachers are trained for online education system.

Virtual teaching education if integrated with traditional classroom lectures for selected topics could be beneficial to the students.

Internet facility is necessary and should be improved to learn virtual learning in mathematics education effectively.

There must be well designed course, sufficient materials and equipment's in online class, internet access, trained teachers and evaluation system to be positive attitude.

Government and non-government sectors should be able to take necessary initiatives to develop schools and universities as free Wi-Fi sector.

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 in the field of implementation.

For virtual teaching and learning there are many opportunities along with challenges so we must focus on implementing the opportunities while facing the challenges.

In order to connect mathematics with technology, various national and international seminars and workshops should be organized and students should be involved in it.

Emphasis should be placed on technology-friendly learning from the primary level.

Suggestions for Future Research

Based on the results of the current study, the researchers would like to suggest the following recommendations.

This study was limited to secondary level student in Kathmandu valley. This can be repeated with different participants from different schools and levels, and their attitudes can be studied.

Conduct similar studies for further investigation of instructors' attitudes towards the virtual learning.

Further studies using the quantitative and qualitative approaches to find out the relationship between students' attitude towards virtual learning.

Study can also be performed to overcome issues and challenges of virtual Learning that is faced by students.

Effectiveness of online learning.

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APPENDICES

APPENDIX-I

Students Interview Guideline

1.   Students Name

2.   Students Age

3.   Students Gender

4.   Students Grade

5.   Do you have a taking virtual class?

   i) Yes   ii) No

6.   Do you use your mobile or any other digital tools at home for taking virtual class?

   ....

   The main question of the research was an investigation of student's attitude towards virtual learning in mathematics education and specially focuses on opportunities and challenges of virtual class in mathematics education. To get answer of these questions were asked:

   1. What is current status of internet access in your home?
   2. How online class being practiced in mathematics education?
   3. How many students taking virtual class in your class?
   4. What are the opportunities of taking virtual class in mathematics education?
   5. What type of the challenges encounter while taking virtual class in mathematics education?
   6. Which software you use for taking virtual class?
   7. Do you want to take virtual classes in future?
   8. Which methods apply for evaluation in virtual class?
   9. How do you feel while taking virtual class?
   10. What do you want to say about online class is relevancy or not?

<center>**Appendix-II**</center>

Teachers Interview Guideline

1. Name of the teacher

2. Temporary Address

3. Campus Address

4. Teaching experience

5. Training

Topics

1. Students attitudes towards virtual learning.

2. Opportunities and challenges of virtual learning in mathematics education.

Interview Questions

1. In what aspects do you think virtual learning design and delivery is different than face-to-face teaching and learning?

2. What do you think that makes virtual teaching and learning successful?

3. What activities would you suggest for virtual teaching?

4. What teaching materials have you used for virtual teaching using?

5. How did you assess students' participation in ZOOM?

6. What are some effective ways of monitoring students' engagement and learning duringvirtual courses?

7. How was the student motivation in virtual learning?

8. Was there enough online discussion with the students?

9. Do you believe that ZOOM is a very good platform for online teaching? Why or why not?

10. How did you motivate shy students to engage in virtual learning?

Appendix-III

Classroom Observation Format/Area

Name of school:

Students' participation:

Date of observation:

Topic:

Teacher Activities

• Teacher's teaching style, method, and materials.

• Interaction between students-students and teacher-students in the virtual class.

• Collaboration and discussion in subject matter with students.

• Virtual learning environment and management.

• Class work and Homework

Students Activities

• Participation of students in virtual class activities

• Students' interest in related topic/content

• Relation between to each other student