

**DIGITAL DIVIDE AND TRANSFORMATIVE PEDAGOGY IN
MATHEMATICS EDUCATION**

**A
Thesis
BY
DIPENDRA YADAV**

**FOR THE PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE
DEGREE OF MASTER'S IN MATHEMATICS EDUCATION**

**SUBMITTED TO
DEPARTMENT OF MATHEMATICS EDUCATION
CENTRAL DEPARTMENT OF EDUCATION
UNIVERSITY CAMPUS, KIRTIPUR
KATHMANDU, NEPAL
2022**

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2022

Letter of Certificate

This is to certify that Mr. DipendraYadav a student of the academic year 2074/75 with Exam Roll Number 7428262 (2075), Thesis No. 1632 and TU registration number 9-2-306-61-2014 has completed this thesis for the period prescribed by the rules and regulations of Tribhuvan University, Nepal. This thesis entitled, "Digital divide and transformative pedagogy in mathematics education" has been prepared based on the results of his investigation. I, hereby recommend and forward that his thesis be submitted for evaluation as the partial requirements to award the degree of Master of Education.

Date: 28 June 2022

.....
Prof. Dr. Bed Raj Acharya
(Head)

Letter of Approval

This thesis entitled “Digital divide and transformative pedagogy in mathematics education” submitted by Mr. DipendraYadav in partial fulfillment of the requirements for the Master's Degree in Education has been approved.

Viva Voce Committee

Signature

Prof. Dr. Bed raj Acharya
(Chairman)

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Dr. RajendraKunwar
(External)

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Mr. Krishna Prashad Bhatt
(Supervisor)

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Date: 16th August 2022

Recommendation for Acceptance

This is to certify that Mr. DipendraYadav has completed his M. Ed. thesis entitled "Digital divide and transformative pedagogy in mathematics education" under my supervision during the period prescribed under the rules and regulations of Tribhuvan University, Kirtipur, Kathmandu, Nepal. I recommended and forward his thesis to the Department of Mathematics Education to organize the final viva-voce.

Date: 28 June 2022

.....

Mr. Krishna Prashad Bhatt
(Supervisor)

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Defense Date: 16 August, 2022

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Dedication

Honestly dedicated

To

My Parents

Who provided me with great opportunities in my study.

Declaration

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

Date: 28 June, 2022

DipendraYadav

Acknowledgment

I am very grateful to the department of mathematics education at T.U Kirtipur for providing me an opportunity to do a thesis on the topic of "Transformative pedagogy in mathematics classroom via Digital technology"

I would like to express my sincere thanks to a respected teacher and thesis supervisor Mr. Krishna Prashad Bhatt, Lecturer, Department of mathematics Education, Kirtipur, Kathmandu for his continuous guidance, constructive suggestions, encouragement, generous comment, and valuable suggestion in making the thesis complete. I would like to thank all students and teachers of Shree stream secondary school padrahawa, Shree Malawardevi secondary school Ghargaira-4 Rupandehi and Shree Amawa Secondary school Amawa-2 Marchawari for their special co-operation in my interview, focus group discussion as well as class observation.

I would like to extend special thanks to these schools' Headteachers who permit to collect data in his school as well as who help me to take an interview about transformative pedagogy and the digital divide. I would like to very special thanks to my parent and my family for their love, trust, support, and enthusiasm for the completion of my thesis which is most important for all. I would like to special thanks you to Mr. Kalamuddin Ansari for his encouragement and his valuable support during my master's education.

Date: 28 June, 2022

DipendraYadav

Abstract

This is survey research entitled "Digital divide and transformative pedagogy in mathematics education" The main objective of this study was to explore the use of digital technology practiced in transformative pedagogy of mathematics education and to analyze the practices of digital technology in transformative pedagogy of mathematics education. The ethnography approach among qualitative research design methods was adopted for this study. The central department of mathematics education was selected for the respondent to collect data. 200 respondents were selected for this research which 100 students were in 11 classes and 100 were in 12 classes of mathematics students. The data were collected through interview schedules, classroom observation forms, and Focus group discussions. The collected data were analyzed and interpreted by different themes such as Critical thinking, Constructive learning, Creative learning, Cooperative learning, Enquiry based learning, Productive based learning, Collaborative learning, Centre of interest, and Change laboratory.

After analyzing data the researcher found that mostly mathematics learners are practicing digital technology. In our context, transformative pedagogy is not implemented in the mathematics classroom, but it is used as augmented learning. There is a lack of mathematical digital technology equipment and teaching-learning materials related to mathematical course content. Lack of well-equipped mathematics computer labs and other teaching equipment in universities so it hindrance professors and lecturers in the teaching-learning process. Available materials are not properly implemented in teaching-learning activities. Due to a lack of proper knowledge about digital technology, the learner doesn't utilize it properly. Teacher motivation for practicing digital technology is strong but the lack of facilities for using digital technology is not properly managed. The lack of proper management of curriculum structure in School causes a great hindrance to the practice of digital technology in transformative pedagogy. Lack of internet facility, lack of courses related to ICT, and lack of interest are major influencing factors in practicing digital technology in transformative pedagogy.

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Chapter-I

Introduction

Background of the Study

In contemporary education, mathematics education is the practice of teaching and learning mathematics along with the associated scholarly research.

The area of mathematics education is wider. It is associated with curriculum, teaching, learning, and evaluation i.e. contents, pedagogy, psychology, sociology, anthropology, and technology. What contents? What teaching methods and learning strategies? What assessment? Also the area of mathematics education. The main objectives of mathematics education are to prepare well-qualified teachers in both method and content. Mathematics is generally divided into pure mathematics and applied mathematics in pure mathematics is the study and development of the principles of mathematics for their immediate usefulness in other fields whereas applied mathematics is a branch of mathematics concerned with the physical, biological and sociological world. But mathematics education views mathematics from the educational point of view.

The Digital Divide refers to the gap between those able to benefit from the internet and those who are not. Since the 1990s, potent global movements, including a series of intergovernmental summit meetings, were conducted to "close the digital divide". In other words, the gulf between those who have ready access to computers and the internet, and those who do not." There is a 'digital divide' between rich and poor in terms of computer use".

The digital divide has contributed to differences in development levels among states. The access to information in the developed world is much better compared to the case in the underdeveloped world. This parity has created an economic divide globally since information is critical in facilitating productivity. The digital divide not only compasses opportunities to access or use of ICTs but also includes the ability and knowledge of using these crucial services in contemporary society. The gap between those who can access ICT services and those who can't is witnessed everywhere even within the same organization, and this impacts massively on the

development of an entity. Gender, race, income, and locality are some of the factors that split society into the information rich and the poorly informed conglomerations.

According to Couldry's publication in the *Ukases*, the digital divide is a complex topic that can manifest domestically or internationally and adversely impact the industrialization and development of a nation as well as the productivity of a country.

Digital technology is essential in teaching and learning mathematics to understand the basic concept and the way of problem-solving techniques. The primary observation found that the mathematics lecturers are not fully utilizing digital technology in their classroom while teaching engineering students. A survey was conducted to study the barriers preventing the integration and adoption of digital technology in teaching mathematics. Five major barriers were identified: insufficient lecturer training opportunities, inadequate technical support, lack of knowledge about ways to integrate digital technology to enhance the curriculum, lack of time in the college or university schedule for involving Information and Communication Technology, and unavailability of digital resources for the students to access the necessary mathematical materials. To overcome some of these barriers, this research proposes a prototype system for teaching and learning mathematics. The prototype system consists of three users; administrator, lecturer, and students. It has many amenities such as a lesson planner, assignments, a collection of mathematical tools, resource storage, and mathematical guidelines, the latest research, and projects, a forum, and so on. The prototype system will be prepared for teaching and learning mathematics much more interesting, inventive, innovative, exploratory, and user-friendly manner (Attewell, P, and Winston, H.2003).

The digital divide is about more than just having access to an Internet connection and a computer; it's also about how well you're able to utilize those tools. Researchers find large differences in how effectively various groups of people can use digital technology. Those differences are often referred to as the digital use divide.

Basic digital literacy includes the ability to use input and output devices (such as a mouse, keyboard, or touch screen), an understanding of the structure of the digital environment (what files, folders, scrollbars, links, menus, and buttons mean), and the

ability to interact with digital information (knowing how to save, delete, open, or select).

In the 21st century, knowledge, information, and a highly skilled labor force are increasingly significant determinants of growth in the global economy. But, the digital split is increasing the gap, thereby, barricading students to receive the learning aids. Today, the most discussed issues in the education sector are the availability of access to the internet and technology at an affordable cost with good quality. Since rich people have the money to purchase; they get easy access to the latest technology and get hold of the best available learning aids. As a result, they gain excellence in education while the poor stayed stuck to outdated old ideas to stagnate. Apart from this, students from poor neighborhoods could not gain admission in schools that were adamantly embracing ICT; thus they remained exclusively for the affluent in society. For children in low-income school districts, inadequate access to technology can obstruct them from learning the tech skills that are crucial to success in today's economy.

The massive digital divide gap in education means that it is a great hindrance to the development of underdeveloped areas. The people living in underdeveloped areas are not capable of inventing new technologies and conducting research aimed at promoting the living standards of the populations. The digital split not only impacts the future of young minds but also reduces the chance of having a great career. As a result, students from different backgrounds, geographies, and communities lose their chance to develop innovative solutions and be responsible citizens.

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Digital Divide has become a hot topic for discussion for today's leaders now. It has become necessary for these leaders to provide solutions that can address this gap. It

doesn't matter from where the solutions come, what matters most is it should conquer the mountains of obstacles that exist today. In the end, all that matters is that the digital gap should be closed for the development of people and countries. Following are the ways that can lessen the impact of the digital split in the education sector:

-) Developing countries need to explore new ways to expand information infrastructure, increase access by improving markets, and reduce the cost of service, especially for Internet access.
-) Providing alternative solutions that are cost-effective and affordable for people.
-) Assigning a laptop, tablet, or similar device to each student to support them.
-) Offering wireless access in study halls, the cafeteria, and the library throughout the day.
-) Promoting digital literacy through campaigns or incentives
-) Forming partnerships with successful entities and robust networking.

Transformative pedagogy is an innovative pedagogical approach that empowers learners to critically examine their contexts, beliefs, values, knowledge, and attitudes to develop spaces for self-reflection, appreciation of diversity, and critical thinking.

A progressive educational approach that includes democratic constructivist-based pedagogy for the promotion of social justice and democratic ideals to transform students and Society. Transformative pedagogy empowers learners to engage in dialogue to co-construct meaning from educational material and experiences through an inquiry-based approach (as opposed to what Paul Freire calls a “banking” orientation). It also promotes personal experiences, dialogical pedagogy, and aligning education with social justice.

The practice of transformative pedagogy in an undergraduate teacher education program. The research was guided by two questions: What is the impact of transformative pedagogy on fostering preservice teachers' transformative learning? And what practices of transformative pedagogy impact student transformative learning? Transformative pedagogy is defined as an activist pedagogy combining the elements of constructivist and critical pedagogy that empowers students to examine critically

their beliefs, values, and knowledge to develop a reflective knowledge base, an appreciation for multiple perspectives, and a sense of critical consciousness and agency. The data revealed that student participants evidenced transformative learning, including a reconstructed understanding of social studies and shifting dispositions, an evolving critique of traditional pedagogy, an evolving self-examination and redefinition of self and the teaching role, an emerging sense of social critique, and an evolving sense of advocacy and social responsibility. The data also revealed that practices that foster transformative learning include open spaces for dialogic learning and immersion in authentic learning experiences.

The goal of transformative pedagogy for peace-building is to empower both learners and educators to become agents of change who are ready to stand up for peace and take action based on ethical values that uphold the dignity of all people. The classroom becomes a laboratory or a start-up space where transformational ideas are nurtured and conceived; where socially responsible initiatives are designed with the support of teachers who can nurture meaningful participation. Educators also accompany the learners in the development of learner-led school Initiatives and projects that move beyond the classroom. Teachers play a crucial role in creating safe spaces for meaningful participation and in accompanying the learners in their quest for transformative and collective actions. For this reason, they must be equipped with the necessary knowledge and skills to apply transformative pedagogy. This actively engages learners using participatory methods and creates safe learning environments for dialogue, and sharing and for learners to learn to collaborate and move from individual learning to collective action.

Key aspects of transformative pedagogy are participatory and collaborative learning in support of inclusion, democratic citizenship, freedom of expression, respect for differences, and non-violent transformation of conflicts. At the heart of transformative pedagogy is the active participation of the learner, this model of engaged learning for peace building draws on experiential learning. It requires a democratic and participatory style of teaching (Freire, 1970).

The use of digital technologies in educational activities opens up new opportunities, adequate methods for dissemination and management of digital information, development of necessary competencies based on digital literacy,

ensuring equitable access for all who wish to obtain the necessary knowledge and decision-making skills, ensuring demand for school graduates in the world labor market in the situation of the digital economy.

Justification of the Study

Mathematics education is an essential part of the school curriculum of Nepal. It has been taught as a compulsory subject in school education programs. Although mathematics education has been given an important place in the curriculum of all levels of school education. Most of the students dislike mathematics and are afraid of it.

The global digital divide also contributes to the inequality of access to goods and services available through technology. Computers and the internet provide users with improved education, which can lead to higher wages; the people living in nations with limited access are therefore disadvantaged. The digital divide has contributed to differences in development levels among states. The access to information in the developing world is much as compared to the case in the underdeveloped world. This parity has created an economic divide globally since information is critical in facilitating productivity. The government has proposed online teaching-learning, but a majority of the schools and students in the country do not have computers, much less than the internet.

Transformative pedagogy is an innovative pedagogical approach that empowers learners to critically examine their contexts. Values. Beliefs. Knowledge and attitudes to develop spaces for self-reflection. Appreciation of diversity and critical thinking. Transformative pedagogy creates conditions that support teachers and pupils in developing their identity as whole persons for whom relationships are based on interdependence. It examines conditions that can support them in developing the capacity as "beings-in-relation" as well as "being-in-becoming". Key theoretical perspectives are used to frame the discussion: identity, beliefs and attitude, knowledge, moral-ethical values, social-affective factors, social interaction, collaboration, cognition, and social and wider society.

Statement of the Problem

When I was studying at the secondary level; teachers do not use any technology in teaching mathematics education. They use only the chalk and talk method of teaching and learning mathematics. Digital education has mathematics teaching and learning more advanced and authentic. Digital education in the field of mathematics teaching has not only aroused positive things but also negative ones such as educational inequalities, social-economics differences, and so on. Such differences and inequalities resulted from the unequal access to digital technology the students/individual is known as the digital divide. Through my own experience of teaching at Shree future star English boarding school Rupandehi-6, Parasahawa as well as during my practice teaching of B.Ed., I faced difficulties while teaching and learning mathematics without using technology.

The transformative pedagogical content knowledge is a useful construct for understanding the mechanism of teachers' impact on student achievement. The pedagogical content knowledge plays a vital role in teaching and students learning activities. It gives the knowledge of how to teach when to teach, why to teach, and what to teach to the teacher. It helps the teacher to be a good teacher and perfect teacher. The pedagogical content knowledge and technological knowledge are very important for every teacher to make their teaching learning activities effective and to increase student learning achievement. So I selected this topic to find possible alternative pedagogy techniques within the digital divide in learning mathematics.

Objectives of the Study

The study has the following specific objectives:

1. To find possible alternative pedagogy techniques within the digital divide in learning mathematics.
2. To explore classroom practices of teaching-learning behaviors.

Research Questions

The research questions concerning the study are as follows:

1. What are the possible alternative pedagogy techniques within the digital divide in learning mathematics?

2. What type of technology use your teacher in the classroom teaching mathematics?
3. How are the secondary students perceived by digital technology and social media in learning mathematics?
4. Was there a significant difference between boys' and girls' perceptions of digital technology?
5. Is there any difference in the teaching-learning activities of a teacher having PCK and a teacher without having PCK?

Delimitation of the Study

The study has several delimitations some of which are given below:

-) This study only found the possible alternative techniques within the digital divide in learning mathematics.
-) This study focused on classroom teaching behaviors.
-) This study was only limited to statements to find out the perception of students towards digital technology and social media in mathematics.
-) The research selected the teachers by purposive sampling method which is a non-random sampling method.
-) The researcher selected only two teachers, one teacher having PCK and one teacher without having PCK.
-) The researcher applied only the teacher class observation form and teacher interview schedule to collect qualitative data related to teaching-learning activities of both teachers having PCK and teachers without having PCK.

Definition of Related Terms

The terms which are used in this study are described as follows:

Digital divide. The Digital Divide refers to the gap between those able to benefit from the internet and those who are not.

PCK (pedagogical content knowledge). Pedagogical content knowledge is a type of knowledge that is unique to teachers and is based on how teachers relate their pedagogical knowledge to their subject matter knowledge in the school context, for teaching specific students (Cochran, King, and Dretzner, 1991, p.211). In my context,

PCK is related to the sufficient knowledge of taught chapters where chapters are mensuration and ratio, and proportion.

Perception. Perception is a complex term that cannot be wholly described by any single numerical index and is used to denote a personal inclination, attitude, thinking feel, ideas fears, threats, and conviction about digital technology and social media.

Students. Students are known as a learner, this research is concerned with secondary level mathematics education students in the secondary school, affiliated school of Rupandehi district.

Teacher having PCK. The teacher who has passed B.Ed. degree from faculty of education or got teacher training. In my study I took B.Ed. degree holder teacher as a teacher having PCK.

A teacher without having PCK. The teacher who has passed B.A, B.Sc., B.Com. Degree and also did not get any teacher training. In my study, I took B.A degree holder teacher as a teacher without having PCK.

Transformative pedagogy. The transformative pedagogy is an innovative pedagogical approach that empowers learners to critically examine their contexts, beliefs, values, knowledge, and attitudes to develop spaces for self-reflection, appreciation of diversity, and critical thinking.

Chapter-II

Review of Related Literature

A review of related literature was a summary of the writing of recognized authorities and previous research which provides evidence to the researcher to be familiar with what was already known and what was still known and untested. The review of related literature was a valuable step that guides the researcher to define the problem, recognize its significance and suggest promising data-collecting devices, appropriate study design, and source of data (Khanal, 2074).

Empirical Review

This chapter considers related articles, journals, reports, and previous thesis. I have reviewed some kinds of literature, which were related to my research topic "Digital divide and Transformative Pedagogy in mathematics education." The literature reviews are as follows:

Alrshedi (2012), conducted a study aimed at discovering the degree to which the faculty members at the University of Hail use social media in their teaching. The survey was used to achieve the goals of the study. The sample group was 157 faculty members, representing 10% of the faculty population. The general result in terms of the degree of social media use among the sample group was moderate. The researcher arranged the survey's domains according to the degree to which social media use from the most to the least as follows: Research and idea change, communication with colleagues, continuous learning, and subject design and methods. No significant difference was found between the sample group's responses about their gender or experience except for a significant difference related to gender in the communication with colleague domain.

The same one, Abdullah (2017), conduct a study related to Mathematics Teachers' perception of using social media in their teaching in Tabuk. The purpose of this study was to discover the status of social media use among mathematics teachers in the classroom, determine their perception of using social media in teaching, and discover the differences among participants' responses based on gender, experience, and the level at which they teach. A survey was designed with two domains: the usability of social media, and the importance of using social media. The sample for

the study was 142 mathematics teachers (82 male and 60 female) teaching at different schools in Tabuk, Saudi Arabia. The findings refer to moderate use of social media among teachers, who sometimes use it in their teaching with no specific target; however, they believe in the importance of using social media in their teaching and perceive it positively. Moreover, findings revealed that in both domains, the participant's means differ significantly, favoring female teachers over male teachers; however, there was no significant difference among participants in either domain about experience or level of school taught.

Adam (2015), a substantial body of literature discusses the complexity of integrating technology into teachers' early established pedagogical practices. This paper examines technology-related professional development and its impact on teacher educators' technological and pedagogical practices. The data were gathered from eleven teacher educators through an ethnographic approach that took place during two visits to the research site. Concerning the first visit, the researcher spent six weeks "hanging out" with the participants, interviewed them individually, and observed six participants' classroom teaching. Then, with the second visit, the researcher spent five weeks "hanging out", and organized focus group discussions with ten participants. Lastly, she had follow-up interviews to clarify and validate the main understandings. The findings were generated through various strategies adhering to grounded theory. Key findings identified two types of professional learning: one is formally designed by the institution and the other is which occurred informally between colleagues. The findings also suggest that teacher educators continued using digital technologies in their early established pedagogical practices without necessarily bringing a change to their approaches to teaching. This paper argues that professional development does not help teacher educators change their pedagogical practices unless it is connected with their backgrounds and the context of practice.

Attewell and Winston (2003), the purpose of this study was to discover the status of social media use among mathematics teachers in the classroom, determine their perception of using social media in teaching, and discover the differences among participants' responses based on gender, experience, and the level at which they teach. A survey was designed with two domains: the usability of social media, and the importance of using social media. The sample for the study was 142 mathematics

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In the context of Nepal, there are so many studies on information and communication technology in mathematics. In this regard, Acharya (2015) conducted a study on the "Effectiveness of GeoGebra software on mathematics achievement". To compare the achievement of the topic learning circle by using GeoGebra software with the achievement of students taught without using GeoGebra software. He flows Vygotsky's social constructivist theory. The research design was quasi-experimental so he makes two groups one experimental group having 28 students and another control group having 25 students. The data collection tools were analyzed by mean, variance standard deviation, and t-distribution at the 0.05 level of significance. The researcher conducted that the GeoGebra software has effective tools in mathematics teaching and leanings, especially in learning circles. The GeoGebra software has a positive impact on students in the topic circle and students have a positive perception of GeoGebra software.

Pulami (2007), his research entitled "Teaching Effectiveness of Trained and Untrained Teacher, A comparative study" was conducted in the Jhapa district with the purpose to compare the teaching effectiveness of trained and untrained teachers. Class observation, questionnaire, and interview tools were applied for data collection. The research concluded that there is only slightly a difference in teaching effectiveness between trained and untrained teachers. Only nominal affection for training is found in the teaching performance of trained teachers.

Khanal (2006), his research entitled "Trained Teachers and Teachers Training" conducted to fulfill the objective of finding teachers' attitudes towards trained teachers and teachers training and concluded that teachers have a positive attitude towards teacher training and teacher training is a part of professional development.

Subedi (2001), conducted research entitled. "Training needs Assessment of secondary school mathematics Teacher" concludes that the training needs for the in-service mathematics teacher of secondary school to develop instructional materials, techniques of teaching, and conceptualization of subject matter to teach mathematics.

Neupane (2004), his research entitled "Classroom behavior of trained and untrained teachers" was conducted in six schools of ShivagunjVDC in the Jhapa district, This research was done with the purpose to compare teaching classroom behavior and extra activities of the trained and untrained teacher. To fulfill the objective of the study classroom behavior and extra activities of Nepal and social studies teachers were studied. This comparative study concluded that trained teachers are more active and positive in teaching than untrained teachers.

Jonathan (2011), conducted research entitled "Transformative Pedagogy, Leadership and school organization for the twenty-first-century Knowledge-based economy "Singapore has a high-performing school system; its students top international tests in mathematics and science. Yet while the Singapore government cherishes its world-class 'brand', it realizes that in a globally competitive world, its schools need to prepare students for the twenty-first-century knowledge-based economy (KBE). Accordingly, over the past 13 years, the government has been laying a policy platform conducive to innovative curricula and pedagogy. Despite the government's command and control ethos, and a history of school responsiveness to economic needs, schools have yet to undertake serious transformation in preparing students for the KBE. This article argues that the present focus on innovation in the curriculum, pedagogy, and assessment needs to be accompanied by a simultaneous re-configuration in leadership and school organization, thus generating school-wide transformation. It comprises three parts: the first maps the connectivity between the economic and educational development of Singapore from 1965 to the present; the second outlines the human resource implications of KB-Es for a twenty-first-century curriculum; and the third maps the transformation of school leadership and organization that is needed if curricular and pedagogic innovations are to be successful.

After analyzing and reviewing the above studies, digital technology, and social media were a new way of teaching and learning aspect. But there is no research to

measure students' feelings to use digital technology and social media in their mathematics learning process. So I'm interested to search perception of students towards digital technology and social media in learning mathematics as my research titles also I found the classroom teaching activities of a teacher having PCK are better than teacher without having PCK also I found that most of the researchers used mixed method research design to fulfill the objectives, applied achievement test to collect quantitative data and classroom observation form, interview schedule and FGD to collect qualitative data. Mean standard deviation, variance, and coefficient of variance have been used to analyze quantitative data and thematic approach for qualitative data.

Theoretical Review

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

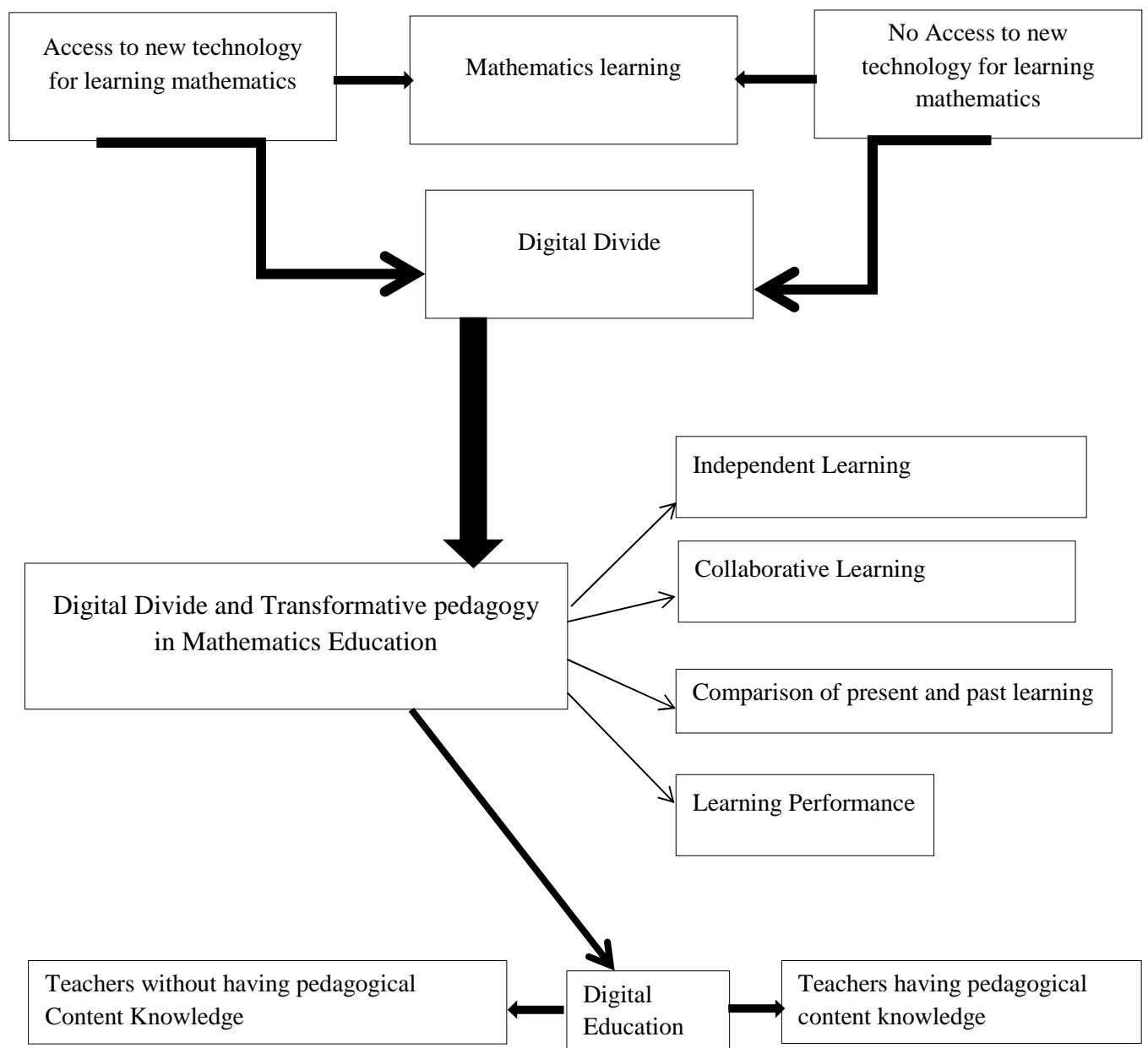
This study has adopted the three-level digital divide framework by Wei er la. (2011) for Investigation of the BYOD classroom initiative to answer the above research question. The three-level digital divide frameworks in outline three stages of the digital divide – digital access divide, digital capability divide, and digital outcome divide. Which can be applied to individuals (students), organizations (schools), and globally (Countries) in the context of ICT interventions. The authors encourage the use of their proposed framework as a theoretical platform for longitudinal studies which are conducted in school computing environments. With the increase in ICT-based teaching and learning efforts across institutions, there is a need to understand the long-term impact of ICT interventions on different levels of the digital divide among the people affected by the three-level digital divide frameworks by Wei er la. (2011) has served as the Theoretical foundation for the current investigation. The framework provided a Comprehensive baseline and allowed this longitudinal inquiry to relate real-world Pedagogical practices with various adoption stages of the one-to-one digital learning Technologies within the BYOD classrooms initiative.

As a teacher, a teacher-educator, and a practitioner-researcher, after a long journey in identifying well-known theories in my field, I became well aware of the

notion that there is no 'royal road' to transformative pedagogy, and also hold a view that grand theories of teaching and researching may not be appropriate in developing myself (and teachers) as a change agent (Pant, Luitel, & Shrestha, 2020). Hence, I believed in the locally developed theory that could serve the needs of my 'self' and 'other-selves' (e.g., students, teachers, parents, school head, etc.) in my study. In this context, I carefully chose Transformative Learning Theory (Mezirow, 1991) and living Educational Theory (Whitehead, 2008), both of which could serve my own as well as my participants' needs throughout the study. Transformative Learning Theory provided me with the new ontological, epistemological, and axiological grounds in research that advocate research as a means for transformative learning (Pant, 2019). Ontologically, it helped me shape my 'being' by integrating different worldviews into my worldviews to transform my 'being' into my 'becoming' through critical self-reflection. Epistemologically, my 'instrumental knowing as being' was transformed into 'communicative knowing as becoming' through transformative learning theory so that axiologically I could widen my horizon of knowing as a synergy of instrumental knowing and communicative knowing for promoting transformative pedagogy. Living Educational Theory guided me in researching and answering a question of the kind 'How do I improve what I am doing?' with the implications that include the generation and sharing of a valid explanation of my educational influences in my learning throughout the study. Whitehead (2008) explained that a living theory is an explanation produced by individuals for their educational influence on their learning, in the learning of others, and in the learning of the social formation in which they live and work. Moreover, both theories helped me examine my teacher-centrist pedagogy and explore the new transformative pedagogy throughout the study.

Conceptual Framework

According to German and Sasses man (1996), a conceptual framework was a written or visual presentation that "explain either graphically or in written form, main things to study the key factors, concept or variables and the presumed relationship them". The following was the conceptual framework of this study. Making a conceptual framework is a challenging job. So I take helped for making this conceptual framework for the topic "Digital divide and Transformative pedagogy in mathematics education". The conceptual framework of this study has been presented below:



Chapter III

Methods and Procedure

Research methodology and procedure will be a guideline that helps the researcher to easily collect and analysis of data. The following methodology will be adopted to achieve the formulated objectives of this study. This chapter includes the design of the study, population, sample and sampling strategy, research tools, sources of data, data collection procedures, and ethical considerations.

Design of Study

In this study, the method of research design will be qualitative design and narrative inquiry. A qualitative research design is concerned with establishing answers to the whys and how of the phenomenon in question. Due to this, qualitative research is often defined as being subjective (not objective), and findings are gathered in a written format as opposed to numerical. Participant observations, in-depth interviews face to face and focus groups will be methodologies considered during the qualitative research design.

The method of research which concerns itself with the present phenomena in terms of conditions, practices, beliefs, processes, relationships, or trends invariably is a term descriptive survey study. I will describe the lives of individuals, and collect and tell life stories or biography. According to Dr. Y.P. Agrawal, (2008) descriptive research is devoted to the gathering of information about prevailing conditions or situations for description and interpretation. This type of research method is not simply amassing and tabulating facts but includes proper analysis, interpretation, comparisons, and identification of trends and relationships.

Study Site

The population of this study consists of all secondary level (Grade 11 and 12) students and teachers enrolled in the affiliated school of the Rupandehi district.

Respondents of the Study

From total students and teachers of secondary level enrolled in the affiliated school of Rupandehi district. I will take any three secondary level(Grade 11 and 12) schools' mathematics teachers and students.

Data Collection Tools

It was an important part of the study. To fulfill the objectives of the research I will use interviews, observation, and focus group discussion for data collection. I would be developed two forms of questionnaire; one is for teachers and another is for students to take interviews. The questionnaire would consist of personal bio-data such as name, age, gender, academic qualification school name, trained or untrained, and length of teaching experience of secondary mathematics teacher.

Observation is the active acquisition of information from a primary source. In living beings, observation employs the senses. In science, observation can also involve the perception and recording of data via the use of scientific instruments, therefore, I would be observed the situation in the classroom when a teacher teaches mathematics. It will give real data for research.

Group discussion improves students thinking, listening, and speaking skills. It also promotes students' confidence levels. It is an effective tool for problem-solving, decision-making, and personality assessment so I will discuss it in groups with students in the classroom about learning activities.

Data Collection Procedure

There are different methods to collect the data. But it is qualitative research, so I needed only data through primary sources i.e. first handed data. First of all for the collection of data I will visit the sample school myself and will meet the responsible administrative staff, head teacher, and mathematics teachers of the school and ask permission for the administration for the questionnaire of secondary level students as well as mathematics teachers of selected schools. After that, I will take interviews with students with the help of questionnaires that will be related to possible alternative pedagogy within the digital divide in learning mathematics, and also I will

take interviews with mathematics teachers about classroom teaching behaviors to collect data. I will also observe the classroom situation of teaching-learning mathematics and discuss group-wise with students in the classroom to collect information to fulfill the objectives of the study.

Finally, I would be thanked all the respondents who consulted and the school authorities of all schools' administrators and teachers for their kind co-operation.

Data Analysis Procedure

Data analysis is considered to be an important step and heart of research in research work. After the collection of data with the help of relevant tools and techniques, the next logical step is to analyze and interperate data to arrive at an empirical solution to the problem (Singh, 2009).

In this study, I will get the qualitative type of data. Qualitative data will be analyzed by the theme analysis method. In this method, qualitative data is coded and integrated codes are integrated to give a title, data will be analyzed based on the same title or theme so first I will prepare and organize my data and print out my transcript, gather my notes, document or other materials after that I will review and explore the data and create initial codes. Again I will review those codes and revise and combine them into themes and finally, I will cohesively present the theme.

Quality Standard. Prolonged engagement in the field and Triangulation were used to maintain the quality standard. After completing the construction of the research tools, it is necessary to maintain quality standards. For the quality standard the reliability and validity of data were maintained by the following techniques:

Triangulation. Triangulation is a method to get an accurate and reliable picture of the situation. The researcher will have to try to understand by collecting different kinds of information from a different perspective, from different sources, and with different tools. Here I will use data triangulation where the data will obtain from class observation, and interview with teacher and students. This will help to maintain the reliability of the data interpretation.

Prolong Stays in the Field. For collecting the data I will stay ten days in a field in which the mathematics classroom will be observed. I will take a school in the Rupandehi district where different social backgrounds students can be found. The interview will have taken few days and school documents (teaching method and materials) will be collected for a few days. The field which I saw and found were taken as the data for research. So I claim the reliability and validity of the data.

Ethical Consideration

Ethical consideration can be specified as one of the most important parts of the research. During this qualitative research, the researcher considered and respected the ethical aspect such as their freedom, secret, social, cultural, gender, and individual right. So I don't hurt the rights of respondents, their feeling, and self-esteem. I will follow all the rules and regulations of related schools for the data collection. I will keep specific attention to student participation anonymity and confidence. During the research, I don't harm participants in any way physically or mentally. The researcher will be explained the true information to the respondent. All activities will be done transparently.

Chapter IV

Data Analysis and Interpretation

This chapter is completely based on the analysis and interpretation of data. To fulfill the research question and to achieve the objectives of my study, the qualitative research design method was used to collect data. Data analysis involves reducing and organizing the data, synthesizing, searching for significant patterns, and discovering what is important whereas Data interpretation is the process of reviewing data through some pre-defined process that helps assign some meaning to the data and arrive at a relevant conclusion. For this purpose, data are collected through the methods of Interview schedule, Focus Group Discussion, and Class Observation form.

In the case of the interview, the researcher reached the Secondary level schools of the Rupandehi district. The researcher had taken interviews with a Secondary level student of the Rupandehi district with the help of the interview schedule prepared by himself which is included in Appendix "A". For the student interview schedule, 10 criteria were used to collect the data. And the researcher interviewed two hundred students in the Rupandehi district through an interview schedule prepared by himself which is included in Appendix "B". In the teacher interview schedule, 10 criteria are included to collect the data.

In the case of the Focus Group discussion, the researcher reached the Shree stream secondary school Kotahimai, Municipality. The researcher had taken permission from the Headteacher and entered the class at the Secondary level and requested 8 students for Focus Group Discussion and record the event through the audacity for the data to fulfill the objectives of the study.

In the case of classroom observation, the researcher used the class observation form as included in Appendix "C". The researcher observed the class for one day in the Central Department of Education and fill-up the form. A classroom observation is a formal or informal observation of teaching while it is taking place in a classroom or other learning environment.

The data were analyzed and interpreted by coding, theming, and categorizing. In this research, respondents are coded as R1, R2, and R3....and Teachers are coded

as M1 and M2.... In this chapter, the researcher tried to know the view on the practices of digital technology in transformative pedagogy and then tries to address his research in two sections, The first section discussed exploring the practices of Digital technology in transformative pedagogy of mathematics classroom and the second section to analysis the practice of using digital technology in transformative pedagogy of mathematics classroom.

View on the Practices of Digital Divide in Transformative Pedagogy

The digital divide is the making, modification usage, and knowledge of tools, machines, techniques, crafts, systems, and methods of organization to solve problems, improve a pre-existing solution to a problem, and achieve a goal or platform a specific function. It can also refer to the collection of such tools, machinery, modification, arrangement, and procedures. Einstein said that his pencil was more intelligent than he was meaning that he could achieve more than using his pencils as an aid to thinking that he is aided. There is a need to recognize that mathematical digital technologies are the pencils of today and that we will only fully exploit the benefits of digital technologies in teaching, learning, and doing mathematics when it becomes unthinking able for a student to solve a complex mathematical problem without needy access to digital technologies tools. (Viberg et al., 2020)

In this perspective when the researcher asked about the View on the practices of Digital Technology in Transformative pedagogy the respondents then they replied accordingly:

R1: *“The use of digital technology such as laptop, iPad, cell phone, etc. in transformative pedagogy develop new ways of learning mathematics. It creates the environment for innovation and change in transformative pedagogy. It boasts of the learning skills and practice of mathematics students while using digital technology in transformative pedagogy. The use of digital technology practiced in transformative pedagogy creates a feeling of cooperation and collaboration. If practices of digital technology are carried out, then it develops a positive curiosity in the learner.”*

- R2: *“Practicing digital technology such as laptops, LCD projector, etc. in transformative pedagogy, makes our teaching-learning task easy, he also said that it enhances creativity, critical thinking, and problem-solving ability of the learner. These are new ways of teaching and learning which shift from old pedagogy to modern pedagogy”*
- R3: *“It has a great impact on teaching-learning activities, in the 21st century, the digital technology such as graphic calculator, graphics tools (GeoGebra, Microsoft Excel, etc.) practicing in transformative pedagogy is game changer instrument for modern mathematics classroom, it plays important role in knowledge acquisition up to high-level domain.”*
- R4: *“I think that practicing digital technology such as blog form, google, youtube, etc. in transformative pedagogy is a challenging task but the concept is good and effective it improves the efficiency of learning by doing and digital technology develops the ability to work collaborate in the field of learning digital technology develops an environment of drill and practice of mathematical content in a smooth way”*
- R5: *“About practicing digital technology such as google classroom, quizzes, etc., she replied that it is a good step for the learner because it creates confidence of reliability and impartibility in learning content, also said that it makes the learner more dependent on self-learning.”*

In this perspective when the researcher asked about the View on the practices of Digital Technology in Transformative pedagogy M1, he replied accordingly:

“In our context, transformative pedagogy is not implemented in the mathematics classroom, transformative pedagogy is used as augmented learning, this means that teacher taught their classes writing on the whiteboard but now it is taught by making slides and presented through PowerPoint, this is not a form of transformative pedagogy.”

In this perspective when the researcher asked about the View on the practices of Digital Technology in Transformative pedagogy in the focus group discussion they replied accordingly:

“About practicing digital technology, they replied, we use digital technology such as graphics tools (google meet, Microsoft team, zoom, etc.) to take online classes, they also said that it changes our learning pattern, it creates greater flexibility concerning location and timing, it enhances creativity, critical thinking and problem-solving ability of the learner, it gives opportunity to learn new things through our-self, it enhances our creativity, critical thinking, and problem-solving ability. These are new ways of teaching and learning that shift from a teacher-centered pedagogy to a learner-centered”

From the above argument, the researcher argued that respondents had no clear concept of the practicing of digital technology in transformative pedagogy. Researcher found that they use different types of digital technologies in mathematics classrooms such as laptops, cellphones, graphics calculators, projectors, etc. It is found that using technology in the mathematics classroom, creates a favorable environment for learners through which students can learn easily and get new knowledge ideas, and concepts. It is also found that the teacher's view is different from a learner on the practicing of digital technology in transformative pedagogy.

Practices of Digital Technology in Transformative Pedagogy of Mathematics Classroom

This study tried to explore the type of digital technologies practiced in transformative pedagogy of mathematics classrooms. This study focused on the addition to requirements of digital technologies and mathematical education systems such as the connection between digital technology tools and mathematics contents. This study focused on the practice of digital technologies in the mathematical classroom to create new opportunities, adequate methods for dissemination and management of digital technologies, development of necessary competencies based on digital literacy, and ensuring equitable access for all who wish to obtain the necessary knowledge and decision-making skills, ensuring demand for e-learning, e-library, and e-education. This study tried to know; why the role of digital technology

is important in transformative pedagogy? Is the appropriate use of digital technology allowing mathematical learners to have the freedom of choice to decide their own time, place, and pace to learn?

Practices of Digital Technology in the Classroom. The classroom is the place where learners gain different types of knowledge and skills to make their plans. Integration of technology in this study refers to making technology positively contribute to the performance of a complex information system that includes formal and informal use of ICTs, in the classroom as well as outside, by students and teachers. Integration also relates to several dynamic factors, including effective practices, technological aspects of new tools, potential to transform learning as well as enable new forms of teaching and learning practices (Howard et al., 2019).

In this perspective when the researcher asked about the practices of digital technology in the classroom to the respondents then they replied accordingly:

- R1: *“I am using a different kind of digital technology such as laptop, iPad, cell phone, etc. in mathematics classroom for improvement of learning mathematics.”*
- R2: *“I am using a graphic calculator and mobile device in the mathematics classroom to solve statics problems in the secondary level classes.”*
- R3: *“Sometimes, I am using digital technology such as graphic calculator, graphics tools (GeoGebra, Microsoft Excel, etc.) in the mathematics classroom to draw figures and spreadsheets.”*
- R4: *“Often, I used digital technology such as Google, youtube, etc. in the classroom to learn the new mathematical concept in leisure time.”*
- R5: *“I use digital technology such as a projector, laptop, and the mathematical app to carry my mathematical task.”*

In this perspective when the researcher asked about digital technology in the classroom during the focus group discussion they replied accordingly:

“About practicing digital technology, they replied, we use digital technology such as graphics tools (google meet, Microsoft team, zoom, etc.) to take online classes, they also said that we also use the graphic calculator and graphic tool in our learning.”

It shows learner uses different kind of digital technology device in the mathematics classroom. It also shows that no continuity in the practice of digital technology devices in the classroom, it also shows that no new digital device is found in the central department of mathematics except computer and projector. It also found that the traditional teaching-learning process has a great influence on practicing digital technology in the mathematics classroom.

Practices of Digital Technology in Teaching Learning Behaviours. Digital technology help student solve their course-related problem in mathematics such as arithmetic, algebra, geometry, Limit, and probability. While doing mathematical academic work as practical work, project work, and presentation of slides we need digital technology. The researcher tries to examine ways of understanding and practicing how students engage with digital media in curricular activities and how these give rise to new practices of information management and knowledge creation. Also, examine how students practice digital technology in class work policies and strategies. It is through the comprehensive study of such practices that we can better understand the efficacy of digital technology in-class work, and the dynamic nature of digital technology is the part of students' practice with using those technologies.

In this perspective when the researcher asked about the practices of digital technology in the assignment, they replied accordingly:

R1: *“I always use digital technology such as GeoGebra and Mathematica in mathematical assignments such as constructing geometrical figures through a laptop in the 12 Grade.”*

R2: *“Yes I often use digital technology to download mathematical pdf for assignments through PC”*

R3: *“I used digital technology such as Gmail, email, etc. to deliver the assignment to the related teacher.”*

R4: *"I use digital technology to prepare power-point slides for presentation in classwork for assignments."*

R5: *"I use digital technology to construct mathematical shapes, figures, flowcharts, spreadsheets, etc. for assignment".*

In this perspective when the researcher asked about the practices of digital technology in assignment to the focus group discussion they replied accordingly:

"There was no any rule to use digital technology in the assignment but due to covid-19 such opportunity is increased, generally we take help of digital technology to complete the assignment such as preparing soft-copy for the compulsory subject. In the assignment, it plays a vital role to deliver and receive an assignment online without wasting time and money. Sometimes it creates a great problem due to internet access in many regions of the country."

The above respondent view shows that the practice of digital technology is carried out in the mathematical assignment. It also shows that practicing digital technology in the mathematical assignment is practiced till the covid-19 infection. It is also found that digital technology saves time and money for a student who is away from their classes. It is also found lack of digital technology creates a great hindrance.

Possible Alternative Pedagogy Techniques within Digital Divide in Learning Mathematics

In this study, all students irrespective of their economic backgrounds must have, equitable access to education. The role of digital learning is only going to increase in the future, so you should not scoff at e-learning. This means that when you do digital classes, you should make sure they are done engagingly. Many have migrated their face-to-face training to a video conference format, but sitting on these calls can be intensive. Managing big masses is difficult, and participants' chances for interaction are limited. Treating digital learning like a "normal" classroom, where learners are accepted to listen to long lectures, is not often the best way to conduct classes. Practices of digital technology were analyzed on the positive aspect of transformative pedagogy. These positive aspects are re-generated from the definition

of transformative pedagogy. Transformative pedagogy encourages teachers and students to do much more than transmit information. Rather, this teaching approach seeks to fundamentally and respectfully change students' attitudes and analytic skills to facilitate their growth, regardless of whether the course is delivered through a traditional or online format. Students ideally leave these classes not only more knowledgeable about the content matter but also with an expanded worldview, greater compassion, heightened self-awareness, and a commitment to producing change. (Meyers, 2000)

Critical Thinking. Critical thinking means correct thinking in the pursuit of relevant and reliable knowledge about the world. Another way to describe it is reasonable, reflective, responsible, and skillful thinking that is focused on deciding what to believe or do. Critical thinking is a learned ability that must be taught. Critical thinking cannot be taught reliably to students by peers or by most parents. Critical thinking can be described as the scientific method applied by ordinary people to the ordinary world. Critical thinking is scientific thinking. A scientifically literate person, such as a math or science instructor, has learned to think critically to achieve that level of scientific awareness. (Schafersman, 2008)

On the above topic the view of respondents are as follows:

- R1. *“The use of digital technology in transformative pedagogy develops new ways of learning mathematics. It creates an environment of critical thinking in transformative pedagogy. It boosts up of skillful thinking and reasonable capacity of mathematics students through digital technology in transformative pedagogy for example if someone doubts mathematical content he can take help of google to criticize the doubt full content.”*
- R2. *“Practicing digital technology in transformative pedagogy is a good concept because it makes our work easy, he also said that digital technology such as google, browser, and youtube enhance critical thinking in the mathematics classroom. This is the new way of teaching and learning which shift from a teacher-centered pedagogy to a learner-centered”*

- R3. *“It has a great effect on teaching-learning activities, in the 21st century, the digital technology practicing in transformative pedagogy enhances the criticizing capacity of the learner, it plays important role in knowledge acquisition up to high-level domain for example learner can gain reliable knowledge through mathematical software such as mat lab, Mathematica and so on.*
- R4. *“I think, practicing of digital technology in transformative pedagogy is challenging task but the concept is good, it improves the efficiency of critical thinking by practicing of digital technology such as when learner use software such as GeoGebra, Mathematica, mat lab he/she pursuit reliable knowledge by criticizing the mathematical content through google search.”*
- R5. *“About practicing digital technology, she replied that it is a good step for the learner because it creates confidence of reliability and impartibility of learning content, she also said that it makes the learner more dependent on self-thinking, it enhances the reasoning capacity of the learner by using digital technology such as quizzer, pseudo, etc. it creates greater flexibility concerning location and timing”*

M2 view on critical thinking in transformative pedagogy of mathematics classroom,

“Practicing digital technology in transformative pedagogy is precious for the latest courses because it makes learners reasonable, reflective, responsible, and skillful to learn their course. He also said that these are new ways of teaching and learning which shift from a teacher-centered pedagogy to learner-centered because the student can learn their mathematical content through fairness.”

Focus group discussion view on critical thinking in transformative pedagogy of mathematics classroom,

“Practicing digital technology in transformative learning is necessary for the mathematics classroom because it increases our critical thinking capacity. In

our mathematics classroom, specific digital technology on critical thinking is not practiced yet. Lack of training and campuses administration doesn't give intention on such subject."

From the above argument, the researcher argued that the unappropriated use of digital technology learners cannot enhance their criticizing power. It also shows they are unable to respond satisfactorily to answer how digital technology promotes the acquisition of knowledge in 21st-century skills such as critical thinking. The respondent argued that the importance of digital technology in critical thinking assure a great opportunity how to get better knowledge. It is also found that no training and seminar are held in School due to a lack of skilled manpower.

Constructive Learning. The constructivist theory has been prominent in recent research on mathematics learning and has provided a basis for recent mathematics education reform efforts. Through digital technology, we mean the use of computer and technology-assisted strategies to support learning within schools and colleges. Approaches in this area vary widely but generally involve technology for students, where learners use programs or applications designed for constructing mathematical figures, mathematical symbols, geometrical shapes, and design. This help student to solve their course-related problem in mathematics such as arithmetic, GeoGebra, geometry, calculus, and probability. (Ilomäki&Lakkala, 2018)

On the above topic the view of respondents are as follow:

- R1. *"Yes, I have used digital technology in classwork such as GeoGebra for constructing mathematical figures such as 2D and 3D figures of integration and differentiation smoothly and attractively. For example, I used GeoGebra tools to construct Pythagoras theorem in ICT in mathematics education."*
- R2. *"Digital technology is important in mathematics classwork because it is used for effortlessly drawing mathematical figures. I use youtube, google to know the construction process and steps on how to carry out construction. I used GeoGebra and Mathematica software to draw mathematical figures triangle, parallelogram, and parametric curves."*

- R3. *"Yes, I used mathematical software to design mathematical figures for the better improvement of constructing skills in mathematics. I used digital technology to construct spreadsheets for statics and matrix to solve mathematical problems conveniently. This saves time and labor."*
- R4. *"Yes, I used mathematical software and social media to construct the mathematical figure. I used digital technology to construct mathematical project work by using word and excel. I used digital technology in mathematics classwork through Laptop to draw mathematical figures and shapes."*
- R5. *"Because of using digital technology, many shapes can be drawn within minutes and seconds. I used laptop, projector, and mobiles in mathematics classwork and homework to construct mathematical figures and symbols to present slides."*

M2 view on constructive learning in transformative pedagogy of mathematics classroom,

"In the context of our mathematics classroom, constructive learning is carried simply, no any type of classes is carried especially on constructive learning, but this type of learning is carried in ICT in mathematics education. It enhances learners' use of digital technology to be skillfully and competencies in the field of mathematics education. Due to the lack of a sufficient amount of digital technology tools and computer labs constructive learning is not carried out correctly. "

Focus group discussion view on constructive learning in transformative pedagogy of mathematics classroom,

"We are using digital technologies such as laptops, projectors, and geometrical tools in classwork for the constructive task. But due to a lack of proper management of the system, we are away from such an opportunity. There is much mathematical software which is under implementation in our school due to lack of skilled manpower and traditional curricula."

It is argued that, a lack of skilled manpower and traditional teaching-learning process hindrances our system. It is also found that no type of special class is run on constructive learning. It also found that there is a lack of skilled manpower in school. It is also found that no special digital technologies are run found especially for constructive learning in school. It is also found that no interest of students in the positive aspect of transformative pedagogy.

Collaborative Learning. In this study, the researcher wants to examine digital technologies used by students during collaborative learning in a mathematical classroom at a central department of mathematics education. Research indicates that digital technology can help support transformative pedagogy. Collaborative learning benefits students when learners effectively share the use of ICT platforms for learning. Meaningful digital collaboration encourages students to learn through what they are learning and enriches their experience using ICT. (Mainali et al., 2017)

On the above topic the respondent's view is as follows:

- R1. *"The use of digital technology practiced in transformative pedagogy creates the feeling of collaboration. If practices of digital technology are carried out then it develops positive curiosity to learn mathematical content. Yes, I have used digital technology in homework such as messenger chat, zoom, and mobile to share pdf related to homework."*
- R2. *"Digital technology is important in the collaborative mathematics classroom because it is used for sending and sharing assignments to the teacher and colleagues through g-mail, blogger, and messenger for learning and to attempting the task. It helps us to be smarter in digital technology."*
- R3. *"Yes, I used mathematical software such as Facebook, Messenger, and Microsoft team through PC to do homework in peer-group work which is a form of collaborative learning. It creates a platform for learning in a group with our colleagues. Digital technology creates an environment of interactive learning."*

- R4. *"Yes, I am practicing mathematical digital technology in homework such as zoom to solve mathematical problems and to construct geometrical figures in GeoGebra in the group to share and gain knowledge this is also collaborative learning. This helps us to maintain a good relationship with our colleagues while learning in the group."*
- R5. *"Obviously, in collaborative learning, I use a laptop and mobiles for mathematics homework, classwork, and project work with a peer to create the folder and to solve the arithmetical problem. In collaborative learning digital technology focus on peer work and analysis of progress."*

M2 view on collaborative learning in transformative pedagogy of mathematics classroom,

"But due to lack of proper management of networking system, we are away from the practicing the digital technology in peer-group work. During covid - 19 we were using the laptop to take online classes, we were using laptops and mobile to present the class of the school, and we use pc software such as GeoGebra, latex, Mathematica, etc. learning activities of the class. To create the collaborative learning platforms for the learner to learn significant transformative learners."

Focus group discussion view on collaborative learning in transformative pedagogy of mathematics classroom,

"They say who collaborated obtained an important improvement in their learning than who worked individually. They say collaborated learning brought a significant change in learners because it creates the opportunity for the weak learner to learn easily. In addition, they say it creates a common platform for learners through digital technology such as zoom, google meet, etc."

From the above argument, the researcher can conclude that students are using digital technology such as zoom, Microsoft team, and google classroom to present their classroom activities, it boosts their efficiency in submitting assignments as well

as teachers' efficiency in providing feedback. It also found that digital technology can foster and improve the skill of using ICT to solve problems, which is important for students' collaboration and learning efficiency. It is also found that digital technology creates a digital platform for all learners.

Co-operative Learning. In this study, the researcher wants to explore the different types of digital technologies practiced in cooperative learning of transformative pedagogy. Cooperative learning is the process of breaking a classroom of students into small groups so they can discover a new concept together and help each other learn. Many instructors from disciplines across the university use group work to enhance their students' learning. Whether the goal is to increase student understanding of content, to build particular transferable skills, or some combination of the two, instructors often turn to small group work to capitalize on the benefits of peer-to-peer instruction. Taudiotapef group work is formally termed cooperative learning and is defined as the instructional use of small groups to promote students working together to maximize they have used each other's learning (Johnson, et al., 2008).

On the above topic the respondents' view is as follow:

- R1. *"Yes, I used a laptop, mobile, audio tape recorder, and video recorder tape in learning mathematics to get the attempted goal of learning mathematics. Yes, we are using digital technology in the classroom else, but the use of digital technology is not used in cooperative learning up to now."*
- R2. *"Obviously, without using digital technology we cannot implement cooperative learning. We are using videotape to learn mathematical courses sometimes but cooperative learning is not seen in the mathematics classroom. This cooperative learning able me to learn new things through digital technology."*
- R3. *"Yes, it visualizes the abstract geometrical mathematical concept in 2D and 3D figures easily and so on. So I used mathematical software such as Geogebra, Mathematica, Latex, and Mats lab through PC for*

learning mathematics corporately with my classmates in my leisure time. Formally, such cooperation is not seen yet."

R4. *"Yes, I used mathematical software such as Geogebra, Mathematica, Latex, etc. in learning mathematics through Computer, Laptop, and Projector to share slides of ppt and to solve mathematical problems while learning tasks in classes as cooperative learning".*

R5. *"In the mathematics subject without using digital technology, it is impossible to do learning so I used tablet, mobile devices and Mathematical software to learn cooperative on the digital technology platform. To gain better knowledge cooperation is necessary but it is not done."*

M2 view on cooperative learning in transformative pedagogy of mathematics classroom,

"During teaching-learning tasks, we are using the laptop to teach mathematical content through Google, YouTube, and google-drive, but learning tasks are not carried out properly due to networking problems. Most of our learners are depends upon data packs because they do have not access to e-learning, and e-library so it is great problem for our learning tasks, no one of our learners uses digital technology during cooperative learning because of the lack of proper facilities of networking system and doing in the group."

Focus group discussion view on cooperative learning of mathematics classroom,

"Cooperative learning is not implemented up to now in the department but cooperative learning may change the condition of the mathematics classroom. Through digital technology, cooperative learning can be carried, but it enhances positive learning in the mathematics classroom. We cooperate through digital technology such as creating the group on Facebook."

It concludes that every learner is not practicing digital technologies in the mathematical subject while cooperative learning. It is also found that digital technological tools can help students to get possible feedback, also in large student groups but the practice of digital technology is not carried out properly. The next thing is that cooperative learning is not seen in behavior due to lack of administration but in ICT classes such cooperative learning is seen. Students have less interest in other types of apps related to mathematics content.

Productive Based Learning. This study indicates the development of a program of work that seeks to understand the teaching practices that promote productive dialogue and learning in mathematics classrooms. Over time, it layered increasing attention to the teacher's role and branched out to consider the multiple participation structures in the classroom. The development of a program of work that seeks to identify the nature of student participation in mathematics discussions that is most predictive of student learning, and how teachers can support students to participate in these productive ways. This work originated in research on cooperative/collaborative learning that thought to understand the links between the dynamics of student-directed small-group work and student achievement. (Dysthe, 2016)

On the above topic the respondent's view is as follows:

- R1. *"Yes, I have used digital technology in the mathematics classroom because it dictates mathematical problems in easy ways. We learn mostly through Projector, Computer, mobile, etc. I used GeoGebra software to construct geometrical gifs of the parallelogram, triangle, hexagon, and so on. It is part of productive learning because through it many mathematical concepts can be achieved"*
- R2. *"It is important in the mathematics classroom because it is important for productive learning. Technology and mathematics are two sides of the coin because without digital technology we cannot solve abstract mathematical content. I use a calculator and laptop to construct to draw mathematical figures in an easy way it is the beneficial part of our study."*

- R3. *“Yes, I used for learning mathematical content easily in every branch of mathematics. Each step of this digital practicing brought in a heightened focus on the details of mathematical interaction around mathematics that brought productive learning”.*
- R4. *“Yes, I used mathematical software such as Geogebra, Mathematica, Latex, etc. in mathematics classroom through Computer, Laptop, and Projector to share slides of ppt and to solve mathematical problems for better improvement in mathematical concept and content this enhance productive learning.”*
- R5. *“Using digital technology many problems can be solved, so it is productive. I used a laptop, projector, calculator, scientific calculator, and mobiles in the mathematics classroom to learn mathematical content, symbol, figures, and statics diagram”*

M2 view on productive based learning in transformative pedagogy of mathematics classroom,

“Using technology is the fundamental need of students that can be integral to achieving significant productivity improvements. Digital Technology also has the power to transform teaching by using a new model of teaching such as creating YouTube videos and bloggers are productive learning for mathematics students to share knowledge. Due to lack of ICT center, this type of opportunity is away from us.”

Focus group discussion view on productive based learning in transformative pedagogy of mathematics classroom

“It is productive for every learner because it helps us to access e-learning and e-library. It creates the platform to achieve a different type of practical knowledge related to mathematics. In the school in the Rupandehi district, many efforts are carried out to get the benefits of productive learning. Due to traditional teaching-learning activities, we are away from such benefits.”

Hence, it is concluded that digital technology is practiced in the transformative pedagogy of mathematics classrooms for productive learning. It is found that significant productivity improvements. It is found that lack of an effective ICT center in the school. It is found that traditional learning is rooted in schools. Students have less curiosity about such aspects of transformative learning. **Inquiry-based Learning.** According to Behaviorist philosophy, teaching should emphasize ways to increase desired behaviors, through connectionism or operant conditioning. One key component of this theory is that learning should involve practice and rewards that increase desired behaviors, which is what many educational technology applications are built around. Many apps serve to increase drill practice such as learning a foreign language, doing math drills, or spelling practice, which all help a student's overall learning. Apps and other educational technology that provide incentives for desired behaviors, like earning coins or tokens for correct answers, are a couple of examples of operant conditioning. Inquiry-based learning means learning by trial and error methods. (Viberg et al., 2020)

The researcher interviewed on the above topic then the respondent replied with their view as follows:

- R1: *"Yes, using digital technology in inquiry-based learning is a good concept because it helps us to search for a new thing in mathematics content. I used digital technology for calculating mathematical problems, this gives us chance to learn a new concept through trial and error methods."*
- R2: *"Obviously, digital technology is important in inquiry-based learning because this increase the ability of a learner in self-learning and self-practices. Apps are used for easily drawing mathematical figures but it gives up chance to get new knowledge in the field of mathematics exercise."*
- R3: *"Yes, I used mathematical software such as Geogebra through PC to construct spreadsheet for statics but I was away from such knowledge I practiced many times then I know about such tools to draw"*

spreadsheet in a systematic way this is an example of inquiry-based learning."

R4: *"Yes, I used mathematical software such as Geogebra, Mathematica, Latex, etc. in mathematics classwork through Laptop to solve mathematical problems. But in inquiry-based learning many geometrical figures cannot be drawn at one time through many trials it becomes easy to draw figures."*

R5: *"Because of using digital technology in inquiry-based learning many problems can be solved within minutes and seconds after a long trial and practice. I used laptop, projector, calculator, scientific calculator and mobiles in mathematics classwork to get the new concept in mathematical project."*

M2 view on inquiry-based learning in transformative pedagogy of mathematics classroom,

"Yes, digital technology plays a significant role in inquiry-based learning because when we give some assignment to mathematics learner such as draw a gif of hexagon they use GeoGebra app to construct gif much time to be perfect. Due to lack of adequate technical support, this type of positive aspect is away from our dream."

The researcher interviewed on the above topic then the focus group discussion replied with their view as follows:

"We are using digital technologies in classwork for critically analyzing the given tasks, constructive work, scientific research, and so on. But in the case of inquiry-based learning, many new steps of mathematical problems are generated due to a lack of proper management of digital technology systems, we are away from such new learning opportunities in the field of mathematical field. Lack of time in universities schedule for a project involving transformative pedagogy."

From the above argument, the researcher argued that mathematics students are practicing digital technology inquiry-based learning in little amount. Lack of time in the universities schedule for a project involving transformative pedagogy. Due to a lack of adequate technical support, such aspects are not implemented up to now. It is also found that it helps in the self-learning and self-practicing behaviors of the student.

Centre of Interest. Appropriate use of digital technologies allows learners to have the freedom of choice to decide their own time, place, pace, or path to study. Learners can exchange ideas more personally and directly. The new ways of teaching and learning are underpinned by the constructivist theory of learning and constitute a shift from a teacher-centered pedagogy to one that is learner-centered. Centre of interest means the learner can successfully impart education characterized by imparting instruction, collaborative learning, multidisciplinary, problem solving, and promoting critical thinking skills as strengthening (NCF, 2005).

The researcher interviewed on the above topic then the respondent replied with their view as follows:

- R1: *"Yes, using digital technology is the center of interest for the learner because it helps the learner to prepare their assignment, it helps the learner to read easily through digital apps, it helps the learner to prepare pdf file, a gif file in math apps. It is a place where we learn and enjoy through the different games."*
- R2: *"Digital technology is important in the mathematics classroom because it is used for sending assignments to the teacher through g-mail, blogger, and messenger so it becomes the center of interest for all learners. One thing that it motivates the learner to learn new things."*
- R3: *"Yes, I used digital technologies to carry out my classes activities and google apps for preparing mathematical project work and for searching the meaning of mathematical word learning convenient way so it becomes center of interest."*

R4: *“Yes, I am practicing mathematical digital technology in mathematics classrooms such as Laptop to solve mathematical problems and to construct geometrical figures in GeoGebra. And it motivates us to learn easily in all mathematical fields so it becomes center of interest.”*

R5: *“Obviously I using the laptop, projector, calculator, scientific calculator and mobiles in mathematics homework to create a folder of homework and to solve the arithmetical problem without such digital tool it is unable to solve such mathematical problem so it becomes center of interest.”*

M2 view on Centre of interest in transformative pedagogy of mathematics classroom,

“Yes it is a center of interest because many educational activities are carried out by using digital technology such as taking online classes during the covid-19 period, to present their task through digital technology, etc is an example of it. Many researchers are surveying digital technology this is a best and contemporary example of interest.”

The researcher interviewed on the above topic then the focus group discussion replied with their view as follows:

“We are using digital technologies at home for completing the given task. But due to the lack of proper management of networking systems, we are away from practicing digital technology in homework. During covid -19 we were using the laptop to take on-line class, we were using laptop and mobile to complete the homework, we use pc software such as GeoGebra, latex, Mathematica to complete the work of class such activity gives a chance to say digital technology is Centre of interest.”

From the above interview, the researcher can conclude that students are using digital technology in the mathematics classroom of transformative pedagogy. It is also found that it boosts their efficiency in submitting assignments as well as teachers' efficiency in providing feedback within a second. It inspires students to learn more and more deeply by using digital technology. Research shows that students are more

interested to solve problems using digital technologies in the mathematics classroom. Research shows that meaningful digital technology apps encourage students to think through what they are learning and enrich their experience using ICT.

Change Laboratory. The student learns the scientific method by actually practicing digital technology in the mathematics classroom. This aspect of transformative pedagogy is so clear in the field of the mathematics classroom. All learners should practice digital technology in the modern era for acquiring knowledge through varied learning methods. Digital technological tools can help students get the best possible education and feedback, also in large student groups. Education should be based on knowledge of how students are best educated and developed. Many digital technological tools help in learning management systems that are more successful in managing learning than supporting the practice of learning, as institutions do not prioritize implementing digital tools in curricula, subject descriptions, and work requirements (Engeström et al., 1996).

The researcher interviewed on the above topic then the respondent replied with their view as follows:

- R1: *"Big mathematical problems are solved in math lab but in our mathematics classroom or schools no any type of invention is carried. It creates a lab for mathematics learners to acquire mathematical knowledge. It helps mathematics learners to free themselves from biases and confusion through digital technology. "*
- R2: *"Obviously, without digital technology we cannot solve abstract mathematical content so to solve such a problem, it requires a laboratory having modernized digital technology. It changes the learning platform through digital technology such as ethnomathematics concept development."*
- R3: *"Yes, it visualizes the abstract geometrical mathematical concept in 2D and 3D figures easily and so on. So I used mathematical software such as Geogebra, Mathematica, Latex, Maths lab through PC for learning mathematics it changes lab for the single learner to the group of the learner."*

R4: *"Yes, I used mathematical software such as Geogebra, Mathematica, Latex, etc in learning mathematics through Computer, Laptop, and Projector to share slides of ppt and to solve mathematical problems while learning tasks this is a lab for the mathematical student.*

R5: *"In the mathematics subject without using digital technology it is impossible to do learning so I used tablet, mobile devices and Mathematical software to learn so this change the lab of the mathematical learner."*

M2 view on Change Laboratory in transformative pedagogy of mathematics classroom,

"Sure, digital technology plays important role in the laboratory to search for new things and to intervention new concept of mathematics in the 21st century, it is a platform through which much scientific inquiry is carried out"

The researcher interviewed on the above topic then the focus group discussion replied with their view as follows:

"During learning tasks, we are using laptop and mobile to learn mathematical content on google, youtube, and google-drive which are forward by our teacher, but learning tasks is not carried properly due to networking problem. Most of our friend depends upon traditional learning because they have not interested in e-learning, or e-library so it is great problem for our learning tasks, no one of our friends uses digital technology during learning tasks because of the lack of net facilities."

From the above interview, the researcher can conclude that every learner is practicing digital technologies in the mathematical subject while learning. Digital technology can reduce the efforts of high labor in mathematics. It increases focus on more important content of mathematics. But the simple type of digital technology is used in the mathematics classroom. It is also found that

Creative Learning. Most learners are used to doing their learning in a classroom with a teacher and peers, while in a creativity program their learning

context is networked. The transfer of classroom activities to the web has to take into consideration that activities suited for creative work often are unsuited for web-based learning. The question: 'How can creative learning be digitalized?' therefore guided the transfer process. In the development process, we pictured ourselves as students and tried to figure out what it feels like to communicate via the computer screen. Like other mass media, the web has a subtle quality of addressing one person in particular. It is not solely a question of distributing information to a large number of listeners, viewers, and learners, but also about the affective aspects of the learning process (Lillejord&Dysthe, 2008).

On the above topic respondent view are as follow:

- R1: *"Yes, it helps in creative learning, I have used digital technology in the mathematics classroom to draw 2D and 3D geometrical figures in easy ways. I used GeoGebra software to construct geometrical gifs of the parallelogram, triangle, hexagon, and so on to create a new design figure and statics graph and curve."*
- R2: *"Obviously, It is important in the mathematics classroom because it is used for teaching-learning activities. Technology and mathematics are two sides of the coin because without digital technology we cannot show creativity in geometry and another branch of mathematics. I use a calculator and laptop to construct mathematical figures efficiently."*
- R3: *"Yes, it visualizes the abstract geometrical mathematical concept in 2D and 3D figures easily and so on. I used mathematical software such as Geogebra, Mathematica, Latex, Mats lab through PC, Creativity learning classes I have done in little amount because such classes are not carried out in our school."*
- R4: *"Obviously, I used mathematical software such as Geogebra, Mathematica, Latex, etc. in the mathematics classroom to create new things in the mathematics field. But due to a lack of proper training, I was unable to demonstrate such creative skills in the mathematics"*

classroom. Sometimes I am trying to create a new mathematical figure."

R5: *"Because of using digital technology, it enhances in creative learning such as to construct geometrical figure and different statistical graph and curves but the creativity of generating new thing in the mathematics field, I have not due to lack of math lab and ICT center in University."*

M2 view on Creative Learning in transformative pedagogy of mathematics classroom,

"Yes, digital technology plays a vital role in creative learning because ethnomathematics is an example of creative learning many decorative materials are designed in geometrical shapes and sizes. For example, drawing artificial flowers in the shape of a triangle and circle. Creativity learning is not carried in our context because the courses are not designed in such a way that students can demonstrate creative ability in the field of mathematics."

The researcher interviewed on the above topic then the focus group discussion replied with their view as follows:

"Yes, we are using digital technology in creative learning in little bit amount, such as to draw the geometrical figure and statically figure, but due to lack of proper management of ICT facilities we are far away from such opportunity, but we create many multiple formulae to get the answer of product easily and so on. "

From the above argument, we can say that creative learning is carried out by learners in many fields of mathematics classroom but due to a lack of proper knowledge and training, they are unable to carry such positive aspects of transformative pedagogy in the mathematics classroom. The lack of ICT courses in universities causes a great hindrance in acquiring the benefit of creative learning.

Reflective Based Learning. It is also useful to provide a structure for groups to reflect on what worked well in their group and what could be improved. Graham

Gibbs (1994) in addition to the reflective practices expected around the self-made student teaching videos traditionally used in methods courses, the student-teachers had the opportunity to view and review, select and delete, revise and discuss.

Reflection is the distinguishing attribute of reflective practitioners. The term reflection as developed here merges critical inquiry, the conscious consideration of the ethical implications and consequences of teaching practice, with self-reflection, a deep examination of personal beliefs, and assumptions about human potential and learning. Essential practices for developing reflective-based learning are discussed. Approaching teaching as a reflective practitioner involves infusing personal beliefs and values into a professional identity, resulting in developing a deliberate code of conduct. (Larrivee, 2000)

About this dimension of transformative pedagogy when I took an interview with the following respondent.

- R1: *"Yes, digital technology helps in reflective-based learning, using digital technology in the mathematics classroom because it helps to revise mathematical activities in easy ways by making audio and video clips. We learn mostly through Projector, Computer, mobile, etc in the mathematics classroom but we don't record such activities. I used GeoGebra software to construct geometrical gif parallelogram, triangle, etc. then I can revise how it works by recording in electa recording app to examine myself."*
- R2: *"Obviously, It is important in the mathematics classroom because digital technology is used for teaching-learning activities through which we can get the opportunity to revise and edit our work easily in a digital way, and its focus on how we can improve our learning task in a better way."*
- R3: *"Yes, digital technology helps to visualize the abstract geometrical mathematical concept in 2D and 3D figures easily, and it helps us to delete and review the repeated work. I used mathematical software*

such as Geogebra, Mathematica, Latex, Mats lab through PC which help me in little amount."

R4: *Yes, digital technology helps me in reflective-based learning, I used mathematical software such as Geogebra, Mathematica, Latex, etc. in the mathematics classroom through Computer, Laptop, and Projector to revise and review what I have read and what I have remembered.*

R5: *"Because of using digital technology many problems can be solved within a minute and seconds but what I have got while solving such problem, this problem answer I got through digital technology I revised and review through digital technology. Mostly I used scientific calculator and mobiles in mathematics classroom while doing the operation on the number."*

M2 view on Reflective based Learning in transformative pedagogy of mathematics classroom,

"Yes, digital technology help learner to reflect on their work easily whatever they learn in the classroom, digital technology help learner to describe their work easily by stepwise method whatever they have learned this is the important thing for all mathematics learner and student. But this type of activity is rare in our teaching-learning context"

The researcher interviewed on the above topic then the focus group discussion replied with their view as follows:

"We are using digital technologies in reflective-based learning for example completing the given task of campus. But due to a lack of proper knowledge about the different systems, we are away from the review and revision of digital technology in the mathematical assignment. During covid -19 we were using the laptop to take the online class at that time we record the video and audio of the teacher what the lecturer taught and we review that video many

times to get proper knowledge. In the absence of better knowledge, we are using digital technology in reflective-based learning."

From the above argument, the researcher concluded that the learner was unable to reflect on the positive aspect of using digital technology in transformative pedagogy. In reflective-based learning, the learner is trying to reflect in little amount but due to a lack of proper management of digital technology, they are far away from their target. This study indicates there is a lack of proper knowledge in students.

In the context of Classroom Observation, the researcher found the following things,

"When I entered into the classroom, the teacher was teaching through the use of book whiteboard and marker, the size of the classroom and number of students was good because there were no more than 40 students in the respective classroom. The classroom environment was good. The environment of practicing digital technology was satisfactory, but there was a whiteboard instead of a digital board that was used by the lecturer. There were no other teaching materials related to digital technology, the next thing was that the teacher was showing a PowerPoint slide that was prepared by him. No use of the net while teaching, only the traditional teaching-learning process was carried out. The learner interaction was satisfactory with their respective mathematics lecture. In the case of learning, the material teacher uses their laptop and the learner uses a cellphone, scientific calculator, and laptop. The assignment was done in a peer group on some specific subject. In the name of digital technology teachers and learners use the laptop, cellphone, scientific calculators, etc. In the case of pedagogy augmented learning is used instead of transformative pedagogy. The library facilities and condition of computer lab were little bit satisfactory. The number of the overhead projector and LCD computer was satisfactory. The teacher's motivation for the use of digital technology was effective. The lecturer's behavior with the learner was effective. The language used by the teacher was English and Nepali while the

teaching and gesture of the teacher were better. The design of the curriculum was yearly-based. ”

From the above class observation form, the researcher found that teaching-learning activities are carried through the traditional method, the management of computers is not satisfactory, the curriculum of schools level programs was yearly-based, and the library management was not so good. Thus, the researcher concluded that practicing digital technology in transformative pedagogy of mathematics is in worse condition.

Chapter V

Findings, Conclusions, and Recommendations

This chapter consisted gist of the whole thesis or we can say that this chapter clarifies those previous chapters which are included in this thesis. Findings, conclusions, and recommendations were presented based on the results in the analysis and interpreted chapter.

Finding

Under the curriculum design, schools suffer from a serious design, curriculum were structured in such a manner that they cannot increase their critical thinking and constructive learning without implementing transformative learning. In the transformative pedagogy, constructivist and critical pedagogy empowers students to examine critically their beliefs, values, and knowledge to develop a reflective knowledge base in this view, the quality of teaching and learning should be upgraded in such a way that learners can achieve productive based knowledge. Not surprisingly, there is as yet no standard statistic that corresponds to this notion of critical thinking and constructive parameter. An abundance of research shows that alternatives to the traditional yearly gap, classroom-based lecture method produce more learning.

It is found that mostly, teaching-learning activities are carried out through old pedagogy. The assignment, project work, and peer group work were less effective in the comparison of transformative pedagogy definition. It is found lecturer method was carried out, without focusing to improve the critical thinking, constructive pedagogy, creativity of the student, and collaborative learning in university classes. It also found that digital technology practicing in transformative pedagogy is less effective. It is also founded that role of digital technology is very important in transformative pedagogy. From the above argument, the management of ICT subjects should be at the secondary level. It also found that in our context transformative pedagogy is not implemented in our mathematics classes. Despite this, practicing digital technology in transformative pedagogy enables the student to be self-dependent, and self-motivated, learning by doing concepts in the field of mathematics but it is not implemented properly due to lack of computer lab, math lab, and net facility and weak provision. Another problem is the weak and less supportive environment and administration is

the certain problem of practicing digital technology in transformative pedagogy. Based data collection from the field and its interpretation dragged researchers to the following major finding:

- In our context, transformative pedagogy is not implemented in the mathematics classroom, transformative pedagogy is used in the form of augmented learning.
- Less intention of the school management committee, so learners and lecturers enable to reflect critically on their educational roles, therefore global crises such as less intensive and less-devoted to educational processes.
- Unavailable Transformative professional development training, so lecturers are unable to take educational activities such as developing curricula, implementing pedagogies, and initiating structural change in their personal and professional contexts.
- One of the major outcomes of research is less curiosity of school-level students about transformative pedagogy content and its implication in digital technology so better implementation is not carried out yet.
- Lack of well-equipped mathematics computer lab and other teaching equipment in school so it hindrance professors and lecturers to practice digital technology in the transformative learning process.
- Due to a lack of proper knowledge about digital technology, the learner doesn't utilize it properly in transformative pedagogy.
- Teacher role as facilitators in transformative pedagogy but facilities provided by teacher is productive less due to a lack of well-skilled manpower in digital technology.
- Lack of proper management of curriculum structure in school causes a great hindrance in practicing digital technology in transformative pedagogy so learner interest is harassed day by day.
- Lack of internet facility, lack, of course, related to ICT, and lack of interest are major influencing factors in practicing digital technology in transformative pedagogy.
- No specific type of digital technology is practiced in specific aspects of transformative pedagogy.

- A specific type of workshop and assignment related to transformative pedagogy is not carried out in school classes of the mathematics department.

These are the problem that hinders the practicing of digital technology in transformative pedagogy. If school administration, teachers, and learners took certain minor intentions on the problem then it can have been solved easily. For this loyalty, related stakeholders must pay few contributions from their sides as well as students.

Conclusion

From the above findings, researchers conclude that practicing digital technology is a good concept in transformative pedagogy but it is a little bit challenging to practice a different type of digital technology in mathematics classrooms due to the lack of internet access and curriculum structure. In our context, transformative pedagogy is not implemented in the mathematics classroom, transformative pedagogy is used as augmented learning. There is a lack of mathematical digital technology equipment and teaching-learning materials related to mathematical course content. Lack of well-equipped mathematics computer lab and other teaching equipment in the university so hindrance professors and lecturers in the teaching-learning process. Available materials are not properly implemented in teaching-learning activities. Due to a lack of proper knowledge about digital technology, the learner doesn't utilize it properly. Teacher motivation in the practicing of digital technology is strong but facilities for using digital technology hindrance. Lack of proper management of curriculum structure in school causes a great hindrance to practice digital technology in transformative pedagogy. Lack of internet facility, lack of curriculum related to ICT, and lack of interest is the major influencing factor in practicing digital technology in transformative pedagogy.

Recommendation

The following are some of the issues not answered and further research to validate the result of the learner are the recommendation for further study. A similar study can be carried out by the researcher on the following topic in another university in Nepal and taking a large sample size in quantitative research design:

- The establishment of a math lab and ICT Centre should be necessary for most schools in Nepal to implement transformative pedagogy systematically.

- Transformative learning theories should be taught at the graduate and postgraduate levels of the mathematics curriculum.
- The government of Nepal and mathematical organizations should pay attention to the management of mathematical equipment related to digital boards, interactive boards, and mathematical software related to mathematics.
- A timely workshop and seminar paper related to the practice of digital technology in transformative pedagogy should be conducted.
- University administration shall need to conduct training related to digital technology in mathematics.

Reference

- Abdul Lah, S. A. (2017). *Mathematics teachers' perception of using social media in their teaching in Taluk, Saudi Arabia: International journals.*
- Acharya, T. R. (2015). *Effectiveness of GeoGebra software on mathematics teaching.* An unpublished Master's thesis Department of mathematics education T.U. Kritipur, Kathmandu
- Adam, A. (2015). *Professional Development for Enhancing Technology-Integrated Pedagogical Practice: An Ethnographic Study in a Maldivian teacher education context.* The Maldivian national journal of research.
- Adhikari, J. (2018). *Bring your own Devices classroom: Issues of digital divides in teaching and learning contexts.* Massey University; New Zealand.
- Alrshedi, S. (2012). *The degree of use of the member of faculty at the University of Hail to the Social Networking sites in the educational process.* Jordan: Yarmouk University
- Attewell, P. & Winston, H. (2003). Children of the digital divide. In Attewell and N.M.see (Eds), *Disadvantage teen and computer technology Munster,* Germany axman
- Chandra, S. & Patkar, V. (2007). ICTS: A catalyst for enriching the learning process and library services in India. *The International Information & Library Review*, 39(1):1-11.
- Cook, J. P. & Garneau, C. (2019). *Challenging student's belief about mathematics: A liberal arts approach.* Published by the University of Central Oklahoma at jotl.uco.edu.
- Cook, J.P. & Garneau, C. (2019). *Challenging student's belief about mathematics: A liberal arts approach.* Published by the University of Central Oklahoma at jotl.uco.edu.
- Costly, K. C. (2014). *The Positive Effects of technology on teaching and student learning.* Arkansas Tech University.

- Creswell, J. W. (2019). *Educational research: Planning, conducting, and evaluating quantitative and qualitative research*. Boston, MA: Pearson Education, Inc.
- Creswell, J. W. (2019). *Educational research: planning, conducting, and evaluating quantitative and qualitative research*. Boston, MA: Pearson Education, Inc.
- Das, K. (2019). *Role of ICT for Better Mathematics Teacher*. Gobardanga Hindu College, West Bengal, India.
- Dysthe, O. (2016). *Productive learning practice - A theoretical discussion based on two cases*. March. <https://doi.org/10.1080/13639080801957154>
- Engeström, Y., Virkkunen, J., Helle, M., Pihlaja, J., & Poikela, R. (1996). The Change Laboratory as a Tool for Transforming Work. *Lifelong Learning in Europe*, 1(2), 10–17.
- Falcon, R. (2009). Transformative pedagogy: From high stake testing to culturally responsive mathematics application. *Italian Journal Article*.
- Ilomäki, L., & Lakkala, M. (2018). Digital technology and practices for school improvement: innovative digital school model. *Research and Practice in Technology Enhanced Learning*, 13(1). <https://doi.org/10.1186/s41039-018-0094-8>
- Israel, O. (2015). *Effects of mathematics innovation and technology on students in open distance learning*.
- Jonathan, W. P. Goh (2011). *Transformative Pedagogy, Leadership and school organization for the twenty-first-century knowledge based economy: The case of Singapore*.
- Joshi, D. (2009). *Use of ICT by secondary school students of Nepal*. Tribhuvan University and Nepal Open University
- Khanal, J. R. (2006). *Education background teacher and teacher training research*. An unpublished master thesis, K.U, Dhulikhel

- Khanal, P. (2073). *Research methodology in education*. Kathmandu: Sunlight Publication.
- Khanal, P. (2074). *Research methodology in education*. Kathmandu: Sunlight Publication.
- Luitel, B. C. (2018). *A mindful inquiry towards transformative curriculum vision for inclusive mathematics education*. Research Paper, Kathmandu University.
- Makarova, E. L. & Makarova, E. A. (2018). *The blending of pedagogy and digital technology to transform the educational environment*. Taganrog Institute of Management and Economics, Russian Federation and Southern Federal University, Russian Federation. article, doi:10.5937/ijcrsee1802057M
- Mezirow, J. (2003). Transformative Learning as Discourse. *Journal of Transformative Education*, 1(1), 58-63. DOI: 10.1177/1541344603252172
- Ministry of Education (2014). *Nepal Education in Figure-2014 at a glance*. Nepal Ministry of Education.
- Larrivee, B. (2000). *Transforming Teaching Practice : Becoming the critically reflective teacher Reflective Practice : International and Multidisciplinary Perspectives*. 1:3(March 2013), 293–307.
- Mainali, B., Key, M., Macy, M., Xin, X., Da, W., Xiaoxu, Z., Xuejie, L., Viberg, O., Grönlund, Å., Andersson, A., McNicol, S., Lewin, C., Keune, A., Toikkanen, T., Vindaca, O., Lubkina, V., Dorji, K., Tshering, P., Wangchuk, T., ... Poikela, R. (2017). CULTURE, WORLDVIEW AND TRANSFORMATIVE PHILOSOPHY OF MATHEMATICS EDUCATION IN NEPAL: A Cultural-Philosophical Inquiry. *Philosophy of Mathematics Education Journal*, 8(1), 1–413. https://doi.org/10.1007/978-3-319-17187-6_8
- Meyers, S. A. (2000). *Using transformative pedagogy when teaching online*.
- MoE. (2013). Information & Communication Technology (ICT) in Education Master Plan 2013-2017. *Ministry of Education Nepal, March 2013*, 1–52.

- Neupane, E. R. (2004). *Classroom behavior of trained and non-education background teachers, A comparative study*. An unpublished Master thesis T.U. Kathmandu
- Pulami, M. B. (2007). *Teaching effectiveness of trains and non-education background teachers: A comparative study*. An unpublished master thesis Department of curriculum and evaluation, T.U. Kathmandu.
- Salonen A. O., Siirilä J. (2019) Transformative Pedagogies for Sustainable Development. In: Leal Filho W. (eds) *Encyclopedia of Sustainability in Higher Education*. Springer, Cham. https://doi.org/10.1007/978-3-319-63951-2_369-1
- Shrestha, I. M., Luitel, B. C. (2020). *Exploring transformative pedagogy in teaching mathematics*. Mathematics Education Forum Chitwan, Nepal
- Singh, K. (2007). *Quantitative social research methods*. Los Angles: Sage Publication.
- Subedi, K. P. (2001). *Training needs assessment of secondary school mathematics teacher*. An unpublished Master's thesis, Department of curriculum and evaluation, T.U. Kathmandu
- Taylor, L. M, Casto, D. J. & Wall, R. T. (2007). Learning with versus without technology in elementary and secondary school. *Computers in Human Behavior*, 23, 798-811.
- Viberg, O., Grönlund, Å., & Andersson, A. (2020). Integrating digital technology in mathematics education: a Swedish case study. *Interactive Learning Environments*, 0(0), 1–12. <https://doi.org/10.1080/10494820.2020.1770801>
- Zafran, H. (2019). *A Narrative Phenomenological Approach to Transformative Learning: Lessons From Occupational Therapy Reasoning in Educational Practice*: The American occupation Therapy Association, Inc. doi: 10.5014/ajot.2020.033100

Appendixes

Appendix I

Interview Guidelines for Students

Student's name.....

Date:

Level of student.....

Contact no.....

The following question had been asked to learners of secondary level(Grade 11) students to get the answer to research question 1.

1. What type of digital technology is practiced in the transformative pedagogy of the mathematics classroom?
 - View on digital technology in transformative pedagogy of mathematics classroom.
 - Digital technology practiced in the classroom
 - Digital technology practiced in homework

The following question had been asked to the learner of the secondary level student to get the answer to research question 2.

2. Why Practicing digital technology is a milestone for transformative pedagogy in the mathematics classroom?
 -) View on critical thinking
 -) View on constructive learning
 -) View on Creative learning
 -) View on Co-operative learning
 -) View on inquiry-based learning
 -) View on Productive learning
 -) View on Collaborative learning
 -) View on Centre of interest
 -) View on change of laboratory
 -) View on reflective-based learning

Appendix II
Interview Guidelines for Grade 12 learner

Student's name.....

Date:

Level of student.....

Contact no.....

- View on transformative pedagogy practiced in the mathematics classroom.
- View on digital technology practiced in the mathematics classroom.
- Challenges on the implication of digital technology in transformative pedagogy.
- Opportunity on the implication of digital technology in transformative pedagogy.
- Advantages of digital technology in transformative pedagogy.
- View of lecturer on the positive aspect of transformative pedagogy.
 1. View on critical thinking
 2. View on constructive learning
 3. View on Creative learning
 4. View on Co-operative learning
 5. View on inquiry-based learning
 6. View on Productive learning
 7. View on Collaborative learning
 8. View on Centre of interest
 9. View on change of laboratory
 10. View on reflective-based learning

Appendix III

Interview Guidelines for Focus Group Discussion

- View on transformative pedagogy practiced in the mathematics classroom.
- View on digital technology practiced in the mathematics classroom.
- Challenges on the implication of digital technology in transformative pedagogy.
- Opportunity on the implication of digital technology in transformative pedagogy.
- Advantages of digital technology in transformative pedagogy.
- View of lecturer on the positive aspect of transformative pedagogy.
 1. View on critical thinking
 2. View on constructive learning
 3. View on Creative learning
 4. View on Co-operative learning
 5. View on inquiry-based learning
 6. View on Productive learning
 7. View on Collaborative learning
 8. View on Centre of interest
 9. View on change of laboratory
 10. View on reflective-based learning

