Interdisciplinary Research in Education
Volume 10, Issue 1, 2025: 124-137
DOI: https://doi.org/10.3126/ire.v10i1.86757

Transforming Mathematics Education: Navigating Digital Barriers in Classrooms

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Keywords

Transformative pedagogy, digital barrier, digital technology, critical thinking, collaboration.

Abstract

The nature of mathematics courses often appears complex for the integration of digital technology in classrooms. Practicing digital technology within transformative pedagogy enables students to become self-reliant, self-motivated, and engaged in learning-by-doing. However, its proper implementation in the context of Nepal remains constrained by inadequate infrastructure, such as the lack of computer and mathematics laboratories, unreliable internet facilities, and insufficient institutional support. Traditional methods of teaching, such as drawing figures on the board and relying solely on problem-solving strategies, dominate the classroom practice, limiting the scope of transformative pedagogy. Although some teachers use laptops, projectors, and PowerPoint slides to foster critical thinking and creativity, these efforts remain insufficient to achieve meaningful transformation. This study indicates that digital technology, when practiced effectively in transformative pedagogy, serves as the backbone of sustainable mathematics learning. Even though challenges such as outdated curricula, economic constraints of students, and limited digital-friendly classrooms continue to impede progress. Student experiences during COVID-19, however, demonstrated the potential of digital platforms like Zoom, Messenger, GeoGebra, and Mathematica to create collaborative and engaging learning environments despite existing barriers. The findings suggest that digital technology is not only a tool for solving mathematical problems but also a medium for cultivating curiosity, collaboration, and transformative learning. The implications point toward the urgent need for a sustainable digital plan that emphasizes blended learning, equitable access, and inclusive engagement in mathematics education in Nepal.

Introduction

Educational systems have been greatly affected by global technological changes and resulting reform initiatives. Nowadays, transformative pedagogy is becoming more common in teaching-learning environments with the rapid development of new digital technology; the traditional teaching-learning pedagogy is smoothly transformed in an innovative way known as Transformative pedagogy. 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 (Blaschke & Hase, 2015; Taylor et al., 2012). So, transformative pedagogy is an inseparable part of instruction. Transformative Pedagogy is learning that induces more far-reaching change in the learner than other kinds of learning, especially learning experiences that shape the learner and produce a significant impact, or paradigm shift, which affects the learner's subsequent experiences. Transformative pedagogy is a combination of constructivist and critical strategies to empower students to examine their existing experiences to develop a reflective base, appreciate multiple perspectives, and critical consciousness (Stinson et al., 2012). Transformative pedagogy operationalizes education linked with sustainability. It focuses more on the processes of learning than the accumulation of knowledge to develop the capabilities to improvise, adapt, innovate, and be creative. The process of transformative learning is based on the transformative theory (Baldwin, 2019; Bentz & O'Brien, 2019; Kovacs, 2018; Mezirow & Taylor, 2009; NCTM, 1992).

Creative dialogues and collaboration, substituting the banking pedagogy, are essential for overall competitive learning. Freire (1993) argued for a critical perception of the world, which implies a correct method of approaching reality so that the students can gain a comprehension of total reality. On these contexts how the pedagogical practices are changing, liberating in the context of Nepal, whether the fundamental ideas disorienting dilemma, critical reflection,, perspective transformation, rational discourse/dialogue, autonomous thinking, action and reintegration, and emotional and social support (Freire & Shor, 1987) of transformative education are followed or the conventional problem solving teacher centered pedagogy in mathematics education is yet dominant.

Transformative learning offers a theory of learning that is uniquely adult, abstract, idealized, and grounded, like human communication. It is a theory that is partly a developmental process which magnifies intra-knowledge and inter-knowledge, but more as "learning is understood as the process of using a prior interpretation to create new knowledge for future study (Author, 1998). Respecting the ideas and voice of students, providing the appropriate flexible surroundings that make creative dialogue/discourse of the students during mentorship play a vital role in creative learning. Transformative pedagogy in mathematics education is the approach that challenges the traditional banking concept of education, where students are passive recipients of knowledge, instead positioning them as active co-creators of learning experiences (Freire & Shor, 1987).

Currently, the term pedagogy - the art or science of being a teacher - refers not only to strategies or styles of instruction but also to the facilitation and management of sustainable

transformations, whether individual, social, structural, or institutional. Digital technology tools can be a major factor in developing an exploratory approach to learning mathematics and, in particular, investigating problems from multiple representational perspectives (Eschenbacher & Fleming, 2020). Digital technology tools offer several didactic advantages that can be exploited to promote a more active approach to learning. The integration of digital technology tools supports teachers, educators, and researchers with many new perspectives field. The use of digital technology tools improves student learning, invites deeper thinking, and motivates learning, more efficient and effective learning. The use of digital technology tools in mathematics instruction can change the teaching-learning process of related courses. In the deep-rooted pedagogies, a teacher's quality was assessed primarily in terms of their ability to deliver content in their area of specialization (Eschenbacher & Fleming, 2020). Pedagogical capacity was secondarily important; its development in colleges of education varied a lot by country and culture. In most places, "teaching strategies" overwhelmingly meant direct instruction. In recent decades, technology has been layered on top of content delivery and used primarily to support students' mastery of required curricular content. A transformative pedagogy underlies and contributes to the extent of the change, as more argue for a range of analytical and context-related skills to be developed in students. To operationalize education associated with sustainability, teaching approaches must focus on elements relating to the processes of learning, rather than the accumulation of knowledge, to develop graduates with capabilities to improvise, adapt, innovate, and be creative.

Eschenbacher & Fleming (2020) argue that digital technologies are electronic tools, systems, devices, and resources that generate, store, or process data. Well-known examples include social media, online games, multimedia, and mobile phones. Digital learning is any type of learning that uses technology. In recent years, reference to digital technology in the classroom can be taken to mean digital processing systems that inspire active learning, knowledge construction, inquiry, and exploration on the part of the learners, and which allow for remote communication as well as data sharing to take place between teachers and/ or learners in different physical classroom locations. Capacity emerges from a synergy between the availability of resources, commitment to meaningful projects, and human communities to bring these projects to life. In this regard, the objects of transformative pedagogies take essentially the form of innovative methodologies (acting as conceptual artifacts) for crossing boundaries between strategies of instruction on the one hand, and management of sustainable transformations at the three levels of the individual, the group, and the organization, on the other (Mezirow, 2003).

Shrestha et al. (2020) did research entitled "Exploring transformative pedagogy in mathematics Classroom." In this study auto auto-ethnography as a research method was used. This study was conducted at a private school in Kathmandu. The sample of this study was student of grades IX and x. The data was collected through informal conversations and interviews. They found that the synergy of teacher-centric pedagogy. Another result of this study was an observable distinction between teacher-centric pedagogy and transformative pedagogy; students were also empowered through critical discourse during interaction in the collaborative learning process of mathematics. Moreover, the study helped to raise consciousness in the students to the maximum extent and in the school to some

extent about exercising democratic values for social justice through the transformative learning process. Above all, the researcher envisioned the synergy of teacher-centric pedagogy and transformative pedagogy in the professional life-world, which empowered to provide students with meaningful (authentic, empowering, justifiable, and inclusive) mathematics learning.

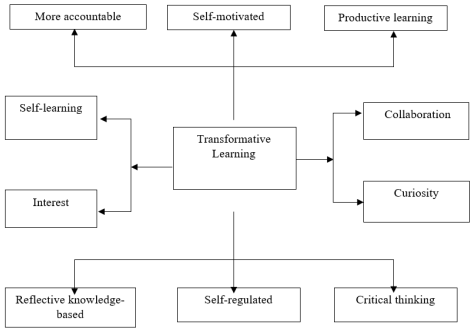

Figure 1: Transformative learning

Research Objectives

This study aimed at exploring the practices of digital technology for the transformative pedagogy of mathematics classrooms within the digital boundary, and analyzing the practices of digital technology in the transformative pedagogy of mathematics classrooms. The focus of the study was on the question, what types of digital technology are practiced, and how the digital boundary has been a barricade for transformative pedagogy in a mathematics classroom in mathematics education.

Methods and Procedures

This section elaborates on research methodology; the selection of the study site and participants, the in-depth interviews as the data collection tool, the data collection procedure, and the analysis. Best et al. (2017); Creswell (2009); Denzin & Lincoln (2018) define research methodology as a theory of how an inquiry should proceed. The study attempted to explore the practice of digital technology in the transformative pedagogy of mathematics classrooms based on students' perception, teacher perception, their experiences, daily classroom practices, advantages and disadvantages, and also analyzes the transformative praxis based on critical thinking, constructive learning, collaborative learning, and co-operative learning. This study was based on the qualitative research design with a narrative approach that especially concerns individual experiences (B. R. Acharya et al., 2021; Houle, 2012). Qualitative research is interpretive in nature, and the theoretical base is subjective reality as truth, a real knowledge. Qualitative research can be regarded as naturalistic inquiry in the sense that it is conducted in the natural setting by trying to avoid any intentional manipulation and distortion of the environment of the informants by the researcher.

Study Site and Participants of the Study

The Central Department of Education, Tribhuvan University, was selected as the study site. This study was based on transformative pedagogy because the educational system nowadays is gradually being transformed into digitalization. The study followd a qualitative design with a narrative inquiry approach. According to Creswell (2007), there is no rule for the sample size in qualitative inquiry. Being qualitative research, the size of the sample is flexible according to the researcher. I used purposive sampling for the study. Therefore, the sample size is 5 gender-inclusive girls' and boys'(2 boys, 3 girls) students, as well as one mathematics teacher. Altogether, 6 participants of the study were from the central department of mathematics education.

The five participants of the study were Lok, Suyog, Samata, Babita, and Savita (pseudonyms). The first participant is Lok, is an M.Ed. fourth-semester student of the central department of mathematics who is studying ICT in mathematics education. The second participant is Suyog, is M.Ed. first-semester student of the central department of education. The third participant is Samata, who is an M.Ed. third-semester student of the central department of education. The fourth participant is Babita who is an M.Ed. Fourth-semester student of the central department of mathematics education, and the last participant is Savita, who is an M.Ed. fourth-semester student of the central department of mathematics education. One lecturer is selected as the participant of this study. Pabitra (pseudo name) is a female mathematics teacher who has 10 years of experience in teaching activities, has done MPhil, and has also had been teaching various content related to ICT and pedagogy subjects at the central department of mathematics education. She had published various research articles related to teaching-learning.

Data Collection Tool

Khanal (2018) visualizes data collection as a series of interpreted activities aimed at gathering good information to answer emerging questions. It is the most important part of the study. An important step in this process is to find people or places to study and to gain access to establish rapport with participants so that they would provide fair data (Stephens, 2009). Research tools are the basic instruments to gather data, to seek possible solutions for observed problems. The Interview Schedule was used as the main tool for data collection.

In-depth Interviews. The interview is a two-way interaction between interviewer and interviewee. The interviewer creates situations that can attract the attention of respondents for enough period in asking questions and answering questions, in which are interviewee puts his/her understanding and meaning. Charmaz (2006); Glesne & Peshkin (1992) describe an interview as a face-to-face interpersonal role situation in which one person, the interviewer, asks a person being interviewed, the respondent, and questions designed to obtain answers pertinent to the purpose of the research problem. This interview helps to create a friendly situation that opens up a free feeling environment for both researcher and respondent. An in-depth interview is a flexible tool for qualitative data collection that enables multisensory channels to be used, for example, verbal, spoken, and heard. The in-depth interviews were administered by deeply exploring the issues related to the study topic and the full range of concepts and ideas of the cultural relevance of mathematics. An interview guideline was prepared with a sequence of questions to evoke a descriptive account of the participants' opinions. The interview often began with a social conversation to build trust and create a relaxed atmosphere so that the researcher could establish a rapport with the participants. Each interview was audio recorded for transcribing, translating, and analyzing.

Data Analysis

Data analysis in qualitative research consists of preparing and organizing, then reducing the data into themes through a process of coding and condensing the codes, and finally representing the data in figures, tables, or a discussion (Author, 2018). The quality of any research work depends upon the set of tools or methods of data collection and techniques used to analyze the data. In this study, the data collected through the above-mentioned tools from various respondents

and sources were processed in several steps. First, the data from the interview on the tape recorder were translated into English. The writing and reading of transcripts would allow me to generate common codes and themes. Methodological triangulation was used by gathering data utilizing different data collection methods, such as in-depth interviews. Data triangulation was secured by using the various data sets that emerged throughout the analysis process (Author, 2018). Three main types of sources were triangulated, including the use of digital technology, the teaching-learning praxis of mathematics, and classroom observation, as well as interviews with a mathematics teacher and students. All transcripts of the interviews and focus group discussions were sent to the participants for feedback. In addition, halfway through the study period, a meeting was held with those who had participated in the interviews, allowing them to correct the interpretation and challenge what they perceived as 'wrong' interpretations (Kothari, 2004). Finally, the findings were presented to the participants in another meeting to confirm the theory. Then, with the help of theories, the analyzed texts were interpreted and summarized. Thus, analysis of the statements from the specific themes was done and theories were used to interpret the meaning, experiences, opinions, and behavior of respondents from the analyzed themes and answer the research questions.

Results and Discussion

In mathematics classes, the teaching-learning activities are mostly carried out through outmoded methods by using chalk and duster (Dhakal, 2019). Sometimes assignments, project work, and peer group work are also given traditionally, such as writing on the board (Dhakal, 2019). The course content is also taught through traditional ways, such as drawing a figure on the blackboard, complex figures of geometrical shapes, and so on. The mathematics teacher only uses outmoded methods and teacher-centered approaches for improving instructional strategies in the mathematics classroom through digital technology such as laptops, overhead projectors, and PowerPoint slides for carrying out teaching-learning activities to improve the critical thinking, constructive pedagogy, and creativity of the student, but it does not give the complete result. The researcher wanted to show that the role of digital technology is very important in transformative pedagogy. After analysis of data, the researcher found that most mathematics students are practicing digital technology in the transformative pedagogy of the mathematics classroom for preparing their mathematical assignments, learning tasks, and drills of mathematics drills. But due to digital boundaries and sluggish administration, the practice of digital technology is not in better condition.

Critical thinking. Critical thinking means correct thinking in the pursuit of relevant and trustworthy 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. A person who thinks critically can ask appropriate questions, gather pertinent information, efficiently and creatively sort through this information, reason logically from this information, and come to reliable and trustworthy conclusions about the world that enable one to live and act successfully in it (Breunig, 2005). Children are not born with the power to think critically, nor do they develop this ability naturally beyond survival-level thinking. Critical thinking is a learned ability that must be taught. Critical thinking cannot be taught reliably to students by peers or by most parents. Skilled and knowledgeable instructors are necessary to

impart the proper information and skills. Math and science instructors have precisely this information and these skills. Critical thinking can be described as the scientific method applied by ordinary people to the ordinary world. Critical thinking is scientific thinking. Many books and papers describing critical thinking present its goals and methods as identical or similar to the goals and methods of science. A scientifically literate person, such as a math or science instructor, has learned to think critically to achieve that level of scientific awareness. But any individual with an advanced degree in any university discipline has almost certainly learned the techniques of critical thinking (Stinson et al., 2012).

The researcher conducted the in-depth interview on the above topic, then the participants replied with their views as follows:

Lok. "*Digital technology is a kind of tool […] which runs through electricity to collect data and information. The use of digital technology in transformative pedagogy, together with critical thinking, develops new ways of learning mathematics. It creates an environment of critical thinking in transformative pedagogy. It boosts skillful thinking and reasonable capacity of mathematics students through digital technology in transformative pedagogy, for example, if someone doubts mathematical content, he can take the help of Google to criticize the doubtful content."*

Suyog. "*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, browsers, and YouTube, enhances critical thinking in the mathematics classroom. This is a new way of teaching and learning which shifts from a teacher-centered pedagogy to a learner-centered"*

Samata. *"It gave a great effect on teaching-learning activities, in the 21st century […] the digital technology practicing in transformative pedagogy enhances the critical capacity of learners […]. It plays an important role in knowledge acquisition up to a high-level domain, for example, learners can gain reliable knowledge through mathematical software such as MATLAB, Mathematica, and so on.*

Babita. *"I think [……] practicing digital technology in transformative pedagogy is a challenging task, but the concept is good […]. It improves the efficiency of critical thinking by practicing digital technology, such as when learners use software such as GeoGebra, Mathematica, MATLAB, they pursue reliable knowledge by criticizing the mathematical content through Google search."*

Savita. "*About practicing digital technology […]. She replied that it is a good step for the learner because it creates confidence in the reliability and impartibility of learning content […]. She also said that it makes the learner more dependent on critical thinking, it enhances the reasoning capacity of the learner by using digital technology such as Quizlet, Pseudo, etc., it creates greater flexibility concerning location and timing."*

Similarly, teachers' viewed on the role of digital technology to promote critical thinking in the transformative pedagogy as:

Pabitra. "*Practicing digital technology in transformative pedagogy is valuable for the latest courses because it makes learner reasonable, reflective, responsible, and*

skillful to learn their course. […]. She also said that it enhances the creativity, critical thinking, and problem-solving ability of the learner. This is 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 reliable and worthwhile sources."

From the above argument, the researcher argued that digital technology, such as laptops, mobiles, and iPads, plays a vital role in the transformative pedagogy in the mathematics classroom (Acharya & Bhatt, 2020).. Through the appropriate use of digital technology, learners can enhance their critical thinking power. Digital technology-supported education can promote the acquisition of knowledge and 21st-century skills such as critical thinking and problem-based learning (Acharya & Bhatt, 2020). Learners can exchange ideas more personally and unswervingly. The learner has the freedom of choice to decide their own time, place, and learning in mathematics content. The respondent argued the importance of digital technology in transformative pedagogy. The researcher has found that there is a high scope of digital technology in mathematics content. They also said it enhances the critical thinking and logical efficiency of the learner. It allows teachers to learn current innovations in teaching around the globe. Using technology creates a tangible environment for the learner through which students can learn easily and get new knowledge, ideas, and concepts to criticize any mathematical topic. It provides the facilitation of exploring new elements in the domain of mathematical knowledge. Digital technology, such as Microsoft Teams and Zoom, is a platform through which learners can interact with each other easily from an online mode in the modern age. It helps the learner to practice and drill their mathematical content on an interactive digital board. The view was positive on digital technology because it creates an environment of a learning hub. The researcher can argue that practicing digital technology is necessary for all learners to improve their reading and learning capacity. This also develops the confidence level of students in learning mathematics. This develops some alternative ways for the learner to read mathematics content at any time and from any place.

Constructive learning. Through digital technology, we mean the use of computers 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 designs. This helps the student to solve their course-related problem in mathematics, such as arithmetic, geometry, calculus, and probability. In today's world, education is facing major challenges; it is expected to provide the learner with competencies they will need in the future, to consider informal ways of learning, and to apply digital technologies and modern pedagogical methods to answer these challenges (Glasersfeld, 1991). However, our curriculum has not managed to meet all these challenges: e.g., digital technology has not yet been applied much in education.

The researcher conducted the in-depth interview on the above topic, and then the participants replied with their views as follows:

Lok*: "Yes, I have used digital technology in classwork, such as GeoGebra for constructing mathematical figures, such as 2D and 3D figures of projective geometry and differential*

geometry, smoothly and attractively. For example, I use GeoGebra tools to construct Pythagoras' theorem in ICT in mathematics education."

Suyog. "*Digital technology is important in mathematics classwork because it is used for drawing mathematical figures easily. He also said that […] I use GeoGebra and Mathematica software to draw mathematical figures, triangles, parallelograms, and parametric curves."*

Samata." *Yes, I used mathematical software such as GeoGebra through a PC to construct a spreadsheet for statistics and a matrix to solve the mathematical problem conveniently."*

Babita. "*Yes, I am a student of ICT in mathematics education; I used mathematical software such as GeoGebra, Mathematica, and LaTeX, etc., in mathematics classwork through a Laptop to draw mathematical figures and shapes."*

Savita. "*Because of using digital technology, many shapes can be drawn within minutes and seconds. I used a laptop, projector, and mobiles in mathematics classwork and homework to construct mathematical figures and symbols to present slides."*

Pabitra. "*We are using digital technologies such as a laptop, projector, and geometrical tool in classwork for constructive work, scientific research, to construct mathematical figures of projective geometry and differential geometry, while teaching and learning activities, and so on. But due to a lack of proper management of the system, together with digital boundary opposition, we are far from such an opportunity.*

From the above argument, the researcher contended that mathematics learners are practicing digital technology such as laptops, mobiles, and overhead projectors in their classroom. In our classroom, the learner is practicing a laptop, calculator, computer, and overhead projector for the presentation of classroom tasks. The students from an underprivileged economic background are still facing digital boundaries like a lack of personal PC, smartphone, consistent internet in their residence, and fewer practices of constructive learning in live classroom activities.

Collaborative learning. The analysis is based on recordings of student in-depth interviews in small groups of five students during mathematics class. The learner could easily ask each other about the meaning of difficult words as a part of the collaborative activities they were accustomed to. Digital Technology makes abstract ideas more visible and makes them easily such as assignments can be completed via digital tools. Although it would seem the opposite to the conventional coursework that students complete with pen, pencil, and paper, it should be noted that, in a broad sense, digital homework includes homework that students write on paper but also requires using the computer and/or internet assistance for its completion. 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 (Corte et al., 2002).

In this regard, the participants shared as:

Lok. *"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. I have used digital technology in homework, such as Messenger chat, Zoom through laptop and mobile for calculating mathematical problems, and sharing PDFs related to homework in digital platforms."

Suyog. "*Digital technology is important in mathematics homework because it is used for sending and sharing assignments to the teacher and colleagues through Gmail, Blogger, and Messenger for learning and to attempting the task."*

Samata. "*Yes, I used mathematical software such as Facebook, Messenger, and Microsoft Teams through PC to do homework in peer-group work."*

Babita. *"Yes, I am a student of ICT in mathematics education; 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 to gain knowledge."*

Savita.*" I use a laptop and mobiles in mathematics homework, classwork, and project work in peer to create the folder and to solve the arithmetical problem."*

Pabitra "*But due to a lack of proper management of the networking system, we are still away from practicing the digital technology in peer-group work. During the COVID-19 pandemic, we used a laptop to take an online class. We also used a laptop and a mobile device to present to the class of the central department. To complete the teaching-learning activities of the class, we utilized software such as GeoGebra, LaTeX, and Mathematica. This creates the learning platforms for the learner to learn easily in a transformative way."*

From the above excerpts, the researcher concluded that students are using digital technology such as Zoom, Microsoft Teams to present their classroom activities, which boosts their efficiency in submitting assignments as well as teachers' efficiency in providing feedback (if submitted online), and inspires students to learn more and more deeply by providing immediate feedback with collaborative praxis. Digital technology can foster and improve the skill of using ICT to solve problems, which is important for students' collaboration and learning efficiently. Research shows that learners who can solve problems using ICT have higher chances of being experts in digital technologies application, and even earn more than learners without ICT experience. Meaningful digital homework on digital platforms encourages students to think through what they are learning and enriches their experience using ICT.

Co-operative learning. 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. The idea of cooperative learning has been around for decades, but it has never gained the same prominence as blended learning or differentiated instruction. 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. This type of group work is formally termed cooperative learning and is defined as the

instructional use of small groups to promote students working together to maximize their own and each other's learning (Corte et al., 2002). Cooperative learning is characterized by positive interdependence, where students perceive that better performance by individuals produces better performance by the entire group. It can be formal or informal, but often involves specific instructor intervention to maximize student interaction and learning. It is infinitely adaptable, working in small and large classes and across disciplines, and can be one of the most effective teaching approaches available to college instructors.

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

Lok. *"Yes, I used a laptop, mobile, audiotape recorder, and video recorder tape in learning mathematics to achieve the attempted goal of learning mathematics by forming groups in the classroom. Yes, we are using digital technology in the classroom; otherwise, the use of digital technology would not be used properly."*

Suyog. "*Obviously, without digital technology, we cannot solve abstract mathematical content. I use my mobile and laptop to run mathematical software. We are using videotape to learn mathematical courses sometimes, but the mobilization of digital technology is not properly implemented, so we solve the problem by cooperative learning."*

Samata. "*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, MATLAB through PC for learning mathematics corporately with my classmates in my leisure time."*

Babita. "*Yes, I have a personal pc through which I smoothly carried out my learning activities. As a student of ICT in mathematics, I used mathematical software such as GeoGebra, Mathematica, and 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, and share ideas among friends."*

Savita. *"In the mathematics subject, without using digital technology, it is impossible to do learning, so I used tablets, mobile devices, and Mathematical software to learn. To gain better knowledge, cooperation is necessary, but it is not practiced properly."*

Pabitra. "*During teaching-learning tasks, we are using digital tools/software to teach mathematical content through Google, YouTube, and Google Drive, but learning tasks are not carried out properly due to a networking problem. Most of our learners depend upon data packs because they do not have access to e-learning, e-library, so it is a great problem in our learning tasks. None of our learners use digital technology during cooperative learning because lack of proper facilities for a networking system and working in the group."*

From the above interview, the researcher established that most of the learners are practicing digital technologies in mathematical subjects while learning. Not all learners are practicing digital technology in cooperative learning for acquiring knowledge. Digital technological tools can help students get the best possible education and feedback, also in large student groups, but the practice of digital technology is not carried out properly. Mathematical Education should be based on knowledge of how students are best educated

and developed. Many digital technological tools help in teaching management systems are more successful in managing to learn than supporting the practice of learning, as institutions do not prioritize implementing digital tools in curricula, subject descriptions, and work requirements. There are many high-quality open learning resources available online. Student response systems can be a way of engaging the students. The findings show that digital technology can reduce the efforts of high laborers in mathematics. It increases focus on more important content of mathematics.

Conclusion

The nature of courses of mathematics looks like complex, so practicing digital technology in the mathematics classroom is a practical issue. Similarly, practicing of digital technology in transformative pedagogy make student able to self-dependent, self-motivated, learning by doing concept in the field of mathematics but it not implemented properly due to lack of computer lab, math lab, and internet facility weedy delivery. Another problem is a weak and less supportive environment and administration is the problem for practicing digital technology in transformative learning. The course content is also taught through outmoded ways such as drawing a figure on the board, amazing figure of geometrical shapes, and so on. The mathematics teacher only uses problem-solving methods and child-centered for improving instructional strategies in mathematics classroom through digital technology such as laptop, overhead projector, and PowerPoint slide to carry teaching-learning activities to improve the critical thinking, constructive pedagogy, and creativity of the student which is not sufficient for transformative pedagogy. The researcher found that digital technology practicing in transformative pedagogy is the backbone for sustainable learning whereas the situation in the center of university is pitiable. Digital technology plays numerous roles in transformative pedagogy. Lack of significant computer lab, digital-friendly classrooms frequent internet facility, expensive data pack, old conventional course nature, economic background of students are the major limitations for the transformative education. Digital boundary and transformative praxis in mathematics classrooms are binary opposition that is contradictory and cannot move simultaneously for the sweeping change in transformative learning. Listening to the above voices, it becomes clear that digital technology has become more than just a tool—it is a bridge for students to stay connected, to share, and to learn mathematics in ways that feel more engaging and collaborative. Whether it is using digital platform to exchange homework, or exploring GeoGebra and Mathematica to solve problems and visualize concepts, students are finding creative ways to make learning meaningful.

At the same time, their stories remind us the barriers of the real struggles: unstable internet, lack of significant digital devices proper management, and the uneven access to resources that hold back the full promise of digital learning. Yet, even with these challenges, the experience during COVID-19 showed how laptops, mobiles, and online platforms opened new spaces where learning could continue. Altogether, these reflections show that digital technology in mathematics education is not just about solving problems but also about creating curiosity, building digital networks in learning, and opening doors to a more collaborative and transformative classroom. With better support and management, the possibilities can only grow richer. The implication of this research is to plan for transformative education via sustainable digital plan in the context of Nepal

that opens the way for blended learning, engagement on digital tools most importantly equity and inclusion.

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