Teaching Practices for Engaged Mathematics Learning with ICT Tools: An Educator's Perspectives

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ABSTRACT: Teaching practice is a training course for the students of Faculty of Education at Tribhuvan University, Nepal. To make teaching practice realistic, practical, skillful, and meaningful, a collaborative approach and information communication technology (ICT) tools play a significant role in mathematics classrooms. In this context, this research study explores the context of student teachers' teaching practice to use engagement learning approaches integrated with ICT tools in the mathematics classroom. Bruner's theory of learning and Kearsley and Shneiderman's engagement theory have been used as theoretical referents of this study. The methodology section comprises class observation of student teachers and an interview session with the head teacher, class teacher, student teacher, and each boy and girl student. The results reveal that an engagement learning strategy enhances interest and confidence among student groups, which is linked to knowledge, strengthening and skill growth for producing qualified human resources in mathematics. This research motivates students, mathematics teachers, and teacher educators.

Context Setting

In my professional journey as a university mathematics teacher and teacher educator, I got opportunities to visit many campuses for class observation during student teacher's teaching practices. In this context, I visited one school in eastern Nepal, named Shree Janata secondary school Morang. I moved to school at 6 a.m. as school ran in the morning in that area due to the hot climate. When I reached school, the class had already started. The school principal was absent, vice principal had managed our class routine. I went to the classroom; the classroom was full of students. I started observing how the teacher was teaching and how students were engaged in grasping the lesson. In the meantime, the attendance was taken and the student teacher started speaking. Teacher: How many of you have memorized the cube formula which I taught you yesterday? Then there was, at once, a pin drop silent, no one had the courage to utter a word. Only two of them had memorized so they raised their hands. Then the teacher turned towards the blackboard, wrote the formula, and asked them to say it aloud unless they

knew it by heart. After that, few of them were able to say it. The class was going on like this. I could sense the atmosphere of conventional teacher centric pedagogy, where the focus was on rote memorization. None of them could not describe the proper concept of how the formula they use came into existence. They were not even aware of the derivation or the visualization of the mathematical formulas.

> In this way, the teacher solved the problem, and students copied the problem. Then, the bell rang and wrapped up the class without assigning any homework. Next year, I attended class observation in the western part of Nepal, i.e., Ambar Secondary School. Then, after, I went to the far-western part of Nepal. The teaching-learning situation was similar to the previous observation, I felt pity for the prevalent teaching-learning system of our country. On top of that, our society was also one of the push factors for dominant traditional culture which was reflected directly on our teaching and learning pedagogy. This lens of reality which was passing around my eyes now and then made me alert about changing my pedagogy starting from myself would probably motivate many of my students.

Based on the above context, I do not remember the exact date, but it was during my journey towards my PhD that I was knowingly and unknowingly walking on the path of transformative learning (Paudel et al., 2023). While striding, I felt that this 21st century is ruled by technology, making it a technological era. Because of that, for our contemporary teaching-learning, there is a need to grow in technological advancement, engagement, and change in mathematics learning. Eventually, as a mathematics educator, I realized that such a rote learning pedagogy always gave rise to linear teaching and learning of mathematics. Mathur and Singh (2023) supported the idea that this type of teaching pedagogy portrays stereotypical acceptance of ancient routines in the classroom. This nature of classroom practice focuses on solving bookish questions and achieving good grades (Lamichhane, 2019). As I observed the situation, I gradually came to the realization that my approach to teaching mathematics had often been reductionist, hindering meaningful learning in the classroom. This led me to question my methods: How can I make mathematics instruction more meaningful? How can I move beyond traditional methods and make learning activities in mathematics more engaging? How can I make mathematics culturally relevant and connect it to students' daily lives? These questions began to occupy my thoughts, and I slowly started to empower myself, continuously improving my teaching practices. Mezirow (1991) supported the idea that transformative learning starts from personal change and empowerment. Then, I began the collaborative approach (Dahal, 2023; Dahal, 2022), student participation, and the use of technological tools in my teaching (Dahal et al., 2022). For this, I interacted with students, discussed, listened to their voices, encouraged and empowered them. I attempted to create a student-friendly environment to produce a favorable setting while students were learning mathematics in the classroom. Similarly in the same manner, I also strived to train them to teach in this kind of pedagogy when they would go for teaching practice in their bachelor-level final year. In this way, all the students were motivated to follow this kind of pedagogy in their professional lives as teachers.

Introduction

It is a well-known fact that the development of the education sector of any nation depends on trained and qualified teachers. Ifunanya et al. (2013) suggested that trained and qualified teachers should be recruited to successfully implement the nation's educational policy. For that, producing trained and qualified teachers for the education faculty at Tribhuvan University Nepal plays an important and fruitful part of the comprehensive program (Dean Office, 2074). The teaching program has been arranged as a compulsory course for students studying a Bachelor's in Education (B.Ed.) for one year and four years and postgraduate for two years at the master's degree (M.Ed.) level. This sort of teaching practice program has produced trained teachers, educational administrators, curriculum makers, and educational planners required by the country. Moreover, various public and private campuses are working under this program.

Teaching practice is the soul of the Faculty of Education. This teaching practice can be compared to a laboratory where the theoretical knowledge learned in the classroom is made meaningful by conducting practical and experimental teaching programs in the supporting school/campus classrooms according to the rules set at certain times (Teaching Practice Curriculum and Curriculum Direction, 2018). This knowledge that the students acquire in the classroom of the campuses prepares them as successful teachers in the future. It is a matter of imperativeness that before entering their professional life journey, students have to be able to put forward their theoretical classroom-based knowledge into practicality, i.e., into real-life scenarios (Wrenn & Wrenn, 2009). In this way, the teaching practice to students develops art of teaching skill by taking it to the actual classroom of the school/university.

For effective and meaningful teaching-learning, different approaches are applied in mathematics classrooms. Among these, collaborative learning and the use of ICT tools play a significant role. A collaborative learning approach incorporates students working together on activities or tasks in a group to ensure everyone participates. In this context, Hossain et al. (2012) explains collaborative learning as an educational approach to teaching and learning that involves groups of students working together to solve a problem. This approach of classroom practice and students' learning strategies in mathematics is high-quality education and the best teaching for skill enhancement (Catalano, 2018). For that, it is necessary to use ICT tools to develop learner-centered teaching and support independent work of collaborating pairs or groups of pupils (Davidsen & Georgsen, 2010). In teaching learning process ICT is used as a tool for meaningful and engaging learning and facilitate cognitive engagement (Buchanan & Lacey, 2019). ICT plays a key role in innovative and creative learning practices to allow students to learn by exploring, creating, playing and self-regulating, personalized learning, and peer collaboration (Pannen, 2014).

As I have discussed above in the context setting, I am walking in the process of transformation and for that I am steadily applying different pedagogical changes in my classroom. In these circumstances, I slowly applied collaborative teaching and learning in my classroom. I could sense that they were grasping these techniques with lot of interest and promised me to follow these methods in their teaching practice and professional life. After finishing classes of the final year of Bachelor of Education, it was time for those students to go in the field for practicals. They went to different schools for teaching practice. As a result, I found myself increasingly intrigued by my students. I wondered about their activities, whether

they were implementing the methods I had taught them, and if their teaching strategies were effective for their own students. I questioned if my student teachers were fostering a learning environment that encouraged collaboration, experience sharing, and the use of knowledge and skills to enhance their students' abilities. From the moment they began their student teaching practice, these questions lingered in my mind. I was particularly interested in whether their classroom engagement had improved. This surge of curiosity propelled me to conduct a research study on their performance. Likewise, many studies have shown that the use of ICT tools, instructional materials, and collaborative learning can significantly enhance motivation and meaningful learning in mathematics (Dahal, 2023; Dahal et al., 2022). However, there seems to be a lack of research on how student teachers apply these practices in the classroom. This research is an attempt to fill the gap. This paper explores student teachers' engagement in teaching/learning by integrating ICT tools and collaborative approaches in school mathematics. To attain the purpose of this research, I have addressed the following research question:

- How are the student teachers engaged in teaching learning in school mathematics using collaborative teaching-learning approaches and ICT tools?

Theory and Literature Review

A literature review discusses published information in a particular subject area within a certain period. My intention was to show how student teachers' teaching practices use collaborative learning and use of ICT tools in their classrooms. For that matter, I found different theories and literature that could assist my study. However, I have selected the most appropriate two theories related to my research, i.e., Bruner's (1996) theory of learning and Kearsley and Shneiderman's (1998) engagement theory. The Bruner (1996) theory of learning emphasizes making mathematical schemas in children's minds. The students are taught by showing, visualizing, and playing. It means the students learn from the action. Therefore, it helps the students have a sort of image of the lesson, which they express through symbols, and it helps to make their concept clear.

Kearsley and Shneiderman (1998) engagement theory focuses that students must be meaningfully engaged in learning activities through interactive participation with others. Its emphasis is meaningful collaboration with peers and the community of practice. In engagement learning, students are intrinsically motivated to do different activities in learning. The major premise of engagement theory is that students must be engaged in their coursework for effective learning. Marshall (2007) explained the engagement theory is a model for teaching learning in technology-based environments. It is an activity-based learning approach, motivation and learning through collaboration and interaction. This theory shows that the students engage in problem-solving to understand the basic concepts of the use of ICT tools in teaching-learning. These two theories guide my research study.

In their case study research, Buchanan and Lacey (2019) found out the advantage of students being immersed in student-centered pedagogy and the idea that ICT tools enhance engagement learning. Collaborating teaching and learning construct the student knowledge and connect with authentic, real-world learning. Contemporary research on the influence of ICT on student engagement and learning suggests that learning environments foster student interest, engagement, creativity, and cognition ability enhancement. Regarding the instructional materials in teaching Loveland (2022) explains ICT tools and instructional materials enhance,

facilitate and make teaching learning easy and lively, and create learning motivation at all levels. Adipo (2015) found that instructional materials make teaching and learning more effective and make the concept clear to the students. Here in this study, ICT is a teaching tool. So this review also supports the idea of my study. Dahal et al. (2020) advocate that using ICT tools in mathematics classroom teaching and learning is more effective, motivating and meaningful learning to the students.

The education policy guides the overall development of education. I made an attempt to address the policy related to my paper. Education Act (2017), the 15th plan approach paper (2020-2021) and the school sector plan (2022/23, 2031/32 of the government of Nepal, all aim to improve the quality of education and student-centered approach. This policy has also advised a teacher to apply different pedagogy and use suitable instructional tools in mathematics class. The basic level curriculum Nepal (2023) of our school education is concerned with meaningful learning and use of ICT tool. For meaningful learning, teachers can motivate students to use different instructional tools and techniques for mathematics teaching. ICT Policy (2017) centers the attention on implementing e-school, e-learning, e-education, and conducting training programs in ICT tool and effective implementation.

Method and Procedures

The research is carried out to go on a voyage of student-teachers' engagement in teaching learning by the integration of ICT tools and collaborative approach in school mathematics (Dahal et al., 2020). In this circumstance of the study, I employed a qualitative approach guided by an explorative method (Aurégan et al., 2023). Observation and interview techniques were used to collect the information. I approached a different school for the research. Then I decided on selecting two government schools to collect the data for the study. The school was in Kathmandu Valley, where my student teacher used to take classes. I used a convenience sampling technique with one head teacher, mathematics class teacher, one male and one female student teacher as a sample from each school for the interview. For the data collection, I visited two government schools in Kathmandu Valley where my student teachers practice in the school. My research study was to find out how the student teacher engages in teaching practice in their mathematics classroom. I had already known the head teacher of the selected school for observation as they were my mathematics students previously. At first, I decided to visit the schools. I informed the head teacher that I would come to his school. So, I visited the first school and consulted the head teacher. I told him about my purpose for the class observation. I requested the head teacher and class teacher to go to class observation with me. He asked me the class that I wanted to visit, and I told him I wanted to go to the class my student teacher taught.

During this process of class observation, the head teacher, class teacher, and I went inside the classroom with the class teacher at the basic level, i.e., class 8. At first, I started to collect data from grade eight male student teachers by observing a teaching-learning process in the classroom. There were 35 students in the class. The student teacher was teaching them a geometry lesson to find out the area of the circle using GeoGebra and verify it experimentally. Similarly, I observed another two classes on different dates and different topics together sitting with head teacher and class teacher. After finishing the observation of three classes, I took an interview with the student teacher, head teacher, class teacher and students. A similar process

for the study took place in another school as well focusing the female-student teacher as a participant. In another school, observation followed by an interview session took place.

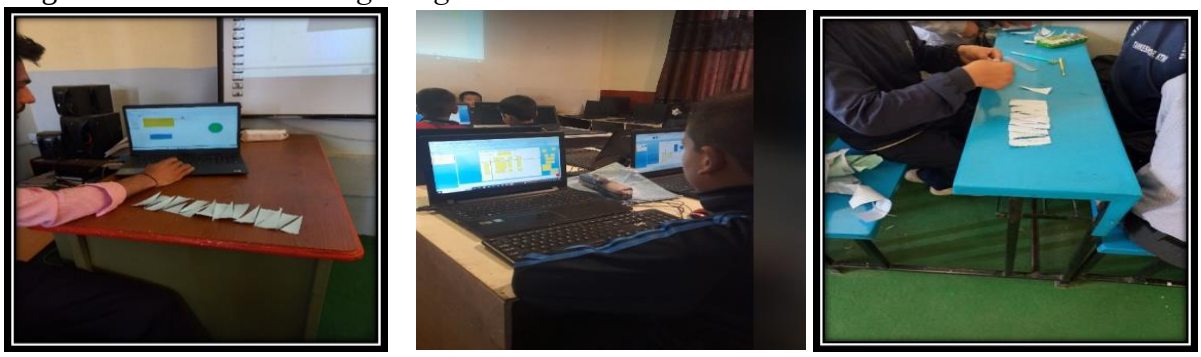
Discussion and Interpretation

The purpose of this study was examining student-teachers engagement in teaching practice through the integration of ICT tools and collaborative approaches. Therefore, the class observation and interview data were analyzed thematically, and two main theme findings were drawn to the use of ICT tools and collaborative approaches, such as "ICT Develops Pedagogical Shift towards Teaching Mathematics" and **"**Collaborative Learning Enhances Motivation and Engagements".

ICT Develops Pedagogical Shift Towards Teaching Mathematics

From the class observation, it indicated that the students were effectively engaged and interested in learning through the use of ICT tools. We can observe in figure 1 below that the teacher and students are visualizing and using instructional materials to construct the circle. In this relation, I asked the male student-teacher participant about what he used to prove the area of the circle and how effective it was. He said, *"I use GeoGebra and paper cutting to teach the students. Yes, I think it was effective as students enjoyed the paper cutting method."* During the class observation, I could also see the classroom was lively as students were enjoying what they were learning. I again asked the female student teacher how she thought that students were clear about this topic. Then she replied, *"I made the concept of the topic clear to the students using ICT tools and instructional materials, and all of the students were able to grasp it well. The students are able to answer the cross questions."* The students also performed well in their class assessment. Theory of learning emphasizes that students are taught by showing, visualizing and playing, and learn from the action (Bruner, 1996). Due to the proper use of visualizing by laptop and instructional materials, the lesson was effective. The objective of the basic level curriculum Nepal (2023) mentioned the necessity of using locally available materials, an instrument box to construct the mathematical figure and for teachers to use appropriate materials and use of ICT tools in geometry. At the time of class observation, it was found that the student teacher and all of the students were using tools and relevant materials.

Figure 1. *Students' learning using ICT tools*



After that I took the view of head teacher about the use of ICT tool, instructional material to teach area of the circle of geometry lesson. He answered,

> I really liked his teaching pedagogy. This was the first time that I experienced this type of teaching learning technique. The previous teachers who used to come here and teach had not used this type of method. Back then when I was a student, my teacher also did not teach me in this way. Now, the process of teaching learning has changed, and it is getting better and better. Recently, few computers have become available in our school computer lab. It is only sufficient to cover some of the students and these have been utilized less than expected. However, the student teacher used them sufficiently. Now, I have decided that I will call him to train the teachers at our school. I felt that in the coming days, we need to train the teachers more in this type of teaching-learning method in order to make them more qualified and skilled, keeping in mind the needs and desires of the students. I asked the same question to the class teacher. He said, "I am a mathematics teacher and I want to use instructional material in geometry teaching, but I am unable to implement the use of it due to lack of knowledge of GeoGebra.

In this regard, ICT Policy, 2017 recommended that the center of attention should be on implementing e-school, e-learning, e-education and conducting training programs in ICT tools and effective implementation. The teachers and the head teachers at the schools were also positive about using the ICT tool, instructional materials, and instrument boxes. It shows that, however, school mathematics teachers needed more knowledge about the use of ICT tools in mathematics lessons. Due to the lack of knowledge and skills in technology, the use of the ICT tool could not be brought up into the classroom. There were available materials such as laptops, projectors, educational softwares that were not used properly as the teachers were not confident enough to implement them. However, the student teacher used the technological materials in teaching practice. This method incorporates a pedagogical shift making teaching practice more viable and practical-based, enhancing thinking, interpersonal, and information communication skills.

Collaborative Learning Enhances Motivation and Engagements

Collaborative learning focuses on students working together in groups or teams to achieve common learning goals. It can be shown through figure 2 below as students and teachers are in collaboration with each other. It promotes learning with active engagement through different teaching materials. Okolie et al. (2021) emphasizes the fact that collaborative learning activities help to improve student engagement in practical skills and motivate students. When students discuss concepts and ideas with peers, they often gain a deeper understanding through explanations and different perspectives.

In this procedure, I asked a female student about use of collaborative learning to teach the geometry lesson, she said,

> *I had a geometry box and other materials as well. The teacher told us to do the task collaboratively. Then we did all the steps as he told us, so I was clear about the concept. Similarly, from this collaborative learning, we learnt to express our thoughts, share our ideas, and respectfully listen to our peers."* After that, I took the view of head teacher about the use of collaborative learning to mathematics lesson. He replied *"I was surprised to see all the students encouraged, motivated, and devoted to working together with their peers. Collaborative learning can boost motivation and engagement to the students. This collaborative learning engagement can lead to more innovative*

and creative solutions to problems. I encourage the teachers to apply this pedagogical approach.

Figure 2. *Students engagement with collaborative learning*

I asked the question to the class teacher about the student teachers' performance. He said

I was really impressed with his teaching approach. Students were more excited about learning when they worked collaboratively with peers. Thus, my eyes opened today, and I could see the reality that teaching can be done through collaborative approach. I realized that teaching learning could be more effective if students were more engaged'. Kearsley and Shneiderman (1998) focuses that students must be engaged in their course work collaboration with peers and intrinsically motivated in order for effective learning to occur. Collaborative learning helps students develop knowledge, skills and deep learning that are transferable to their future careers. Marshall (2007) explains that students engage in teaching learning in a technology-based environment. The use of ICT enhances collaborative learning which can lead to more innovative and creative solutions to problems.

Final Reflection

In teaching practice, collaborative teaching learning, and information communication technology (ICT) tools are prerequisites for mathematics teaching and learning. To make teaching practice practical, skillful, and meaningful, a collaborative approach and ICT tools need to be used in mathematics classrooms. It was found from my personal reflection and class observation that in order to use them in the classroom, resources need to be made available, teachers have to be motivated and trained, and students need to show some interest in them. Similarly, the impact of ICT tools on the teaching and learning process has become pertinent as it facilitates the teaching and learning process, creates a conducive and engaging learning environment, and helps learners to develop creative thinking and self-confidence.

Likewise, the student who was actively engaged in collaborative learning, visualization and using the different instructional materials were successful in gaining the right concept. ICT tools are the storehouse of information that bridges the gap between mathematics teachers and students. This makes mathematics teaching more effective, realistic, and meaningful. We could observe that student teachers' teaching techniques showed the proper use of instructional materials, ICT tools and methodology which produced qualified and skilled human resources.

Collaborative learning helps students develop knowledge, skills and deep learning that are transferable to their future careers. This research is a source of inspiration and eye opener for mathematics teachers, teacher educators, policymakers as well as students and student teachers. For this reason, I want to continue research in this field to go more deeply into effective teaching practice and develop a new theory for myself. Finally, if a nation wishes for a successful outcome of education, a visionary plan for school teachers and ICT tools with a way forward can be adapted for academician, policymaker as well as for all the stakeholders.

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