

MAKING MATHEMATICS PEDAGOGY LEARNERS-FRIENDLY:  
A NARRATIVE INQUIRY

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A Dissertation

Submitted to

School of Education

in Partial Fulfilment of the Requirement for the Degree of  
Master of Philosophy in Mathematics Education

Kathmandu University

Dhulikhel, Nepal

June, 2022

This dissertation entitled: *Making Mathematics Pedagogy Learners-Friendly: A Narrative Inquiry* was presented by Sangita Thapa for the degree of Master of Philosophy in Mathematics Education on June 12, 2022.

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## DECLARATION

I hereby declare that this dissertation has not been submitted for the purpose of any other degrees.

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## DEDICATION

This work is profoundly dedicated...

To the teachers and the teacher educators who hope this work will initiate them to value the significance of making mathematics pedagogy learner friendly.

## AN ABSTRACT OF THE DISSERTATION OF

*Sangita Thapa* for the degree of *Master of Philosophy in Mathematics Education* presented at School of Education, Kathmandu University School of Education on June 12, 2022.

Title: *Making Mathematics Pedagogy Learners-Friendly: A Narrative Inquiry*

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My personal and professional experiences led me to question the ongoing mathematics pedagogy in the secondary schools of Nepal. When I joined a school as a mathematics teacher, I faced a lot of under-achievers in Mathematics. I was perplexed how I could raise their level of understanding in Mathematics. I came to know a lot of lapses that I had performed while being a student of Mathematics during school life and also while being a mathematics teacher in my profession then. The key problem that I saw was the existing pedagogy in the secondary school mathematics classroom. After coming from the UK, I joined MPhil in Kathmandu University, School of Education, where I decided to explore the teachers' and students' perceptions on making mathematics pedagogy learners-friendly.

With a key research question (How do teachers and students narrate their experiences for ways of making mathematics pedagogy learners-friendly?), I commenced academic research, using narrative inquiry and constructivists' theory, covering four different secondary schools. Altogether, four mathematics teachers and

four students were interviewed to collect their opinions and perceptions on learners-friendly mathematics pedagogy. Learners-friendly mathematics pedagogy was found to be a holistic approach that incorporated multiple components. First, the classroom setting appeared to be one of the important components of learners-friendly mathematics pedagogy, in which the proper arrangements of the physical utilities of the classroom was counted as a must. Second, teaching-learning activities in a learners-friendly mathematics classroom was aligned with students' centred pedagogy, in which the learners were focused more in terms of their personal and socio-cultural needs and interests. Third, students' motivation was also focused as the crux of the learners-friendly mathematics pedagogy. Fourth, learning materials to make the pedagogy effective and student-oriented were also reported to be a major component of the learners-friendly mathematics pedagogy. Fifth, assessment of students' achievement was found to be a part of learners-friendly mathematics pedagogy as it opens up the ways to decide whether the classroom pedagogy moves ahead as per the aims of teaching Mathematics. Sixth, students-teacher relationship, on the other hand, also appeared to be one of the key components of the learners-friendly mathematics pedagogy.

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## ACKNOWLEDGEMENTS

This study is an outcome of the support and efforts of many stakeholders including the dissertation supervisors, examiners, adolescent students, my family, and friends. Such support and efforts motivated me to continue and complete this journey. I would like to take this opportunity to express my profound gratitude to all persons who have contributed their invaluable time and support for making my journey an accomplished one.

My heartfelt gratefulness goes to my dissertation supervisor Assistant Prof. Binod Prasad Pant, Who actively contributed his valuable time to the supervision of my dissertation. I incorporated his suggestions and constructive feedback which are very helpful. His continuous monitoring helped me to enhance my interest and so my energies were not shifted to something else. His stimulating discussions throughout the entire preparation of this dissertation has been very helpful to shape it into reality. I take this opportunity to thank him for sharing his ideas and experiences so generously. I would like to express my deepest appreciation to Dean Prof. Bal Chandra Luitel, Ph.D., for his excellent guidance, patience, continuous encouragement, suggestions and endless support from the very beginning to the completion of this dissertation. I would also like to thank all of the KUSOED research committee members.

Similarly, I would like to gratefully acknowledge the support and help of those all who contributed in the different phases of the study. For this, the people of Lalitpur, especially my research informants, helped me by allocating time and sharing their perceptions and challenges to make the research achievable. In addition to the



informants, the support from my friends and the community members were incredibly significant to complete this work in time.

My special acknowledgment also goes to my fellow friends of 2014 February batch (M Phil in mathematics education) for providing infinite suggestions and ideas at the time. I would like to express my heartfelt appreciation to the professors, lecturers, administrative staff, library staff, and all the friends of Kathmandu University for providing suggestion, information, and related materials. I highly appreciate the role of the entire family members especially, my spouse Santos Bhandari and lovely kid Sarvesh Bhandari, who played a great and dynamic role in completing this dissertation. I feel, without their time and efforts, it would have been impossible to complete this work in time. I have appreciated the great patience from them that I could ever have expected. They also helped by waking me from time to time to fulfil my dissertation work in a given time.

I would like to acknowledge all those who have helped me to make my dissertation possible. And of course! Special thanks to Prem Raj Adhikari, and Dinesh Kumar Thapa for their tremendous help in APA format and language editing. I sincerely thank my colleagues who cannot be individually named, but without whom this research would not have been possible.

Finally, I express my gratitude to all members of the School of Education, Kathmandu University and all my colleagues of Shree Mahalaxmi Secondary School, Lubhoo, Lalitpur for their support and cooperation for the completion of this dissertation.

Sangita Thapa, Degree Candidate

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## CHAPTER I

### INTRODUCTION

This chapter discusses the research context, the research agenda, and the problem statement. While doing so, I mostly use my own experiences as a mathematics student and also as a teacher in a school. I, however, substantiate my personal experiences with the evidences available in the related literature to justify the research agenda and the problem, thereby claiming that they are worthy for a research endeavour. Based on the problem statement, I generate the research purposes and the research question that have led me throughout the research. Learners- friendly mathematics pedagogy as my research agenda is the outcome of my experiences in teaching-learning Mathematics, the context of the teaching-learning of Mathematics in Nepal, the learning experiences of the learners in Mathematics, and empirical evidences related to mathematics pedagogy.

#### **Setting the Scene**

Experiences that emerged in my family, school, and community lifeworld often remain as both inspiring and frustrating sources of learning to me. I thought uncovering inspiring and frustrating experiences and narrating the same would contribute to developing a research agenda. I, thus, feel that it would not be helpful for me to merely narrate my experiences because it would cast an impression on my readers that I am not a researcher, but merely a story teller. I, therefore, thought of connecting my narrated experiences with the others who share similar environments in their family, schools, and community, and thereby interpreting the same with reference to some scholarly and established stances, the context, my personal reflexivity, and so on and so forth.

At this point of time while developing my research agenda, my readers may raise the question: Why do I begin *scene setting* of my research in such a way? What experiences would I like to unfold and why? In response to the first question, I would like to portray myself as a qualitative researcher in that I would generate the scene by revisiting self-experiences and those of others in my lifeworld (Thapa, 2020), and thereby creating an opportunity for myself to portray how the recollection and reintegration of small events of life consecutively helped me to emerge my research background and problem (Baral, 2020). By bringing the second question into the notice of myself and my readers, I would like to portray my educational journey that began with my family and community and continued through educational institutions like schools, colleges, and universities.

Being an educational practitioner, re/creating and re/shaping my experiences to give them a legacy of knowledge is an imperative part of my profession and an integral part of my professional development. Aligning with Whitehead and McNiff (2006), I am convinced to view educational research both as a personal and a professional enterprise, which does not only help the researcher to evolve knowledge in the field of his/her research interest but also re/create an opportunity to re/learn and re/interpret the researcher himself/herself and those who share the similar lifeworld. Being a student of Mathematics in my college and university education, I, therefore, thought of how I am similar to and/or different from others, especially in learning and cultivating knowledge in Mathematics through schools, colleges, and university education. As a part of scene setting, I portray my experiences in learning Mathematics in different times of my education in the family, community, and educational institutions and thereby reaching the conclusion on why I selected making mathematics pedagogy learners-friendly as my research agenda.

While going back to my school life, I recollect those experiences which often appeared to be the most challenging ones. I began my school education in a primary school which was located in my village. It was a community school. Out of many subjects that I had to handle in my classroom, Mathematics appeared to be the most peculiar one. It was so because it demanded a lot of time for practice, considerably a fair level of understanding, comprehension skills, and basic knowledge to understand and solve the given mathematical problem. I, along with the other students in the school, was often afraid of Mathematics not only at the time of the periodic and/or annual exam of Mathematics but also while presenting class work and/or homework to my mathematics teacher. I often was under the impression of failing, and/or being punished by the teacher if I solved the given problems in Mathematics improperly. Such a continuous pressure of failing often encouraged me to raise questions: why was this subject taught in school? what was significance of this subject in the life of a human being? Can my life not proceed without knowing Mathematics? Such questions voluntarily occupied my mind then.

Once I consulted one of my classmates sharing the anxiety produced by Mathematics in the classroom. She suggested to me that she often memorized the key sums in Mathematics, as she memorized theorems, profit and loss, unitary methods, and so on and so forth in Mathematics. Since I was not so excellent in memorizing and/or rote-learning, I could not make Mathematics a subject of memorizing. I was seeking a way out to outsmart this subject. I thought I might be under-wit for Mathematics or I have not been able to get access to the required way of getting command over it.

When I re/assess the approach to learning Mathematics during my school years, I uncover my experiences on how my mathematics teacher in school taught me

and in what way his power of being a teacher limited my freedom for asking him time and again to make the teaching of Mathematics more comprehensive. Thus, I questioned: was it the extremely controlled environment in the classroom and hierarchy of teacher-students' relationship that made me face difficulties in learning Mathematics?

Despite being under the pressure of such anxiety in Mathematics, I went on passing this subject every year, from one grade to another. I completed my secondary education with the continuous pains and haunting created by the mathematics subject. The regular classwork and homework of Mathematics engaged me rigorously even though it was an undesirable part of my educational life. I often assessed the use of Nepali subjects in contemporary life and found that it contributes to writing, speaking, listening, and reading in different occasions and so was it in the case of English and Social Studies. But I hardly got such rigorous use of Mathematics in life, except the use of addition, subtraction, multiplication, and division. I, then, asked why my family members and teachers and even community members focused Mathematics to such an extent although it does not seem to be applicable in day-to-day life. It, thus, encouraged me to think that perhaps it is the faulty perception regarding Mathematics and its pedagogy that made me suffer from such difficulties.

On the flip- side, I found the popularity of Mathematics so high among teachers, students, community, and family members, which made me think and rethink to go ahead with Mathematics in the higher education phase of my life. I heard my friends in schools, my parents at home and members in the community talking about earning based on Mathematics. They talked that mathematics teachers earn a lot from tuition classes and that the students majoring in Mathematics can get the opportunity to teach in schools, colleges and universities in various educational



streams. The discourse as such encouraged me to complete my college education majoring in Mathematics. I found the way of teaching Mathematics in schools and colleges was similar. The Mathematics teachers in college often encouraged me to practise a sum many times until it became a part of knowledge. Thus, I began to practise it time and again.

Later in life, I joined a private school as a Mathematics teacher, in which I began to teach Mathematics in the way I was oriented from my school and college teachers. The students in private schools brought considerably better marks in exams. This made me raise a question: what might be there for the students in private and community schools to achieve different levels of scores in Mathematics? Is it the mathematics pedagogy that contributes to enhancing the learning achievements of the students?

My perception towards Mathematics changed when I joined an NGO which was working for the quality education in the rural parts of Nepal. After joining it, I came into a different discourse of teaching Mathematics in schools. It appeared to me of a different flavour that raised my interest in Mathematics further. In due course of time, I got an opportunity to go to the UK as a part of developing an organisation for human resource in education. During my stay in the UK, I learned some key techniques, methods, teacher-student relationship, learning resources, classroom management, particularly in enhancing students' achievement in Mathematics. The knowledge I acquired on mathematics pedagogy in the UK induced me to question my own way of learning Mathematics during my school years. After coming back from the UK, I joined the MPhil course in which I decided to carry out an academic research as a part of my MPhil programme to relearn and reinterpret the ways of making Mathematics learners-friendly in the school education of Nepal.

### **Conceptualizing Learners-Friendly Mathematics Pedagogy**

What does learners-friendly mathematics pedagogy mean? This question needs explicit interpretation in the context of this research. For the purpose of this research, I asserted UNICEF (2020) to mean learners-friendly pedagogy as “a systemic change in educational content and methods, delivered through comprehensive, coordinated programmes that focus on teaching and learning, with the objective of changing classroom practices to ensure that every child learns” (p. 5). This means that pedagogy is supposed to be learners- friendly if it ensures learning on the part of each student in the classroom. But the question in this context is: How can a student learn?

There are various claims to ensure learning on the part of a child. For example, the teacher-centred pedagogy claims that a child learns when a teacher imparts learning items to the students. Such a pedagogy is severely challenged as it overlooks learners’ needs and interests while imparting knowledge and skills in the classroom (Hamdi, 2018). In my opinion, pedagogy can be claimed to be learners-friendly if it suits the age, interests, needs, maturity, and aspiration of the learners in question. In this respect, student-centred pedagogy seems relevant. It aims to foster students’ autonomy in the learning process and ensures their independence in choosing the ways of learning (Endang, 2018). Autonomy and independence of students in learning new experiences under the student-centred pedagogy focuses on skills and practices that enable lifelong learning and independent problem-solving. The student-centered learning theory and practice are based on the constructivist learning theory that emphasizes the learner's critical role in constructing meaning from new information and prior experience (Yunjo, 2020).

By asserting the student-centered pedagogy as a learners-friendly pedagogy, I reveal active, participatory, and engaged learning on the part of the students that enlarges the learning opportunities for the students in the given classroom contexts. Since every student in the classroom differs by their interest, needs, level of motivation, and maturity to learn/acquire new experiences, their intensity of participation and engagement in learning also differ (Sakata, 2021). They enjoy learning depending upon their capacity to learn. For me, this is personalized learning and, hence, such an approach becomes friendly to them.

In this context, I assert that the learners-friendly mathematics pedagogy asserts learners' autonomy and independence in choosing and engaging into classroom activities for learning new experiences in Mathematics. Students in such a pedagogy of Mathematics start their learning by using materials and technologies depending upon their interests and objectives of learning Mathematics.

### **The Study Problem**

I often wondered, during my school years, why Mathematics remains difficult among students. Although I was able to place myself in the top-ten list in Mathematics in my classroom, I was haunted too with the name, i.e., Mathematics. A number of students were underachievers, and that I too would come into the list: the impression as such often tortured me in school. In this context of my research, I wanted to know whether the situation as I felt during my school days remains the same today. I also attempted to know whether the students in schools are still under-achievers, as used to be during my school days. To know this, I went through some national level literature on students' achievements in school Mathematics. In this regard, Education Review Office (2019) maintains that the achievement of the community schools was below the national average. Dalit students are doing

significantly worse in maths. Female students are, on average, faring worse in maths than boys, and the difference is both substantial in magnitude and statistically significant. The data reveal that from the gender perspective, boys' achievement score (n510) was higher than the mean score of the girls (n492), which is lower than the national average (n500) (Education Review Office, 2019). Similarly, 69% of students did not learn the minimum level in grade 10 (Education Review Office, 2019).

The learning achievement in Mathematics is below the average. Further, learning outcomes are weaker in Mathematics. According to Education Review Office (2011), the achievement level based on the hierarchical level of the items of Mathematics shows that the students' ability to solve complex problems was low; only 21% of the maximum scores were reached. In the day-to-day Mathematics classroom learning situation, students feel difficulties and show poor performance in comparison to other subjects. The difficulty encountered by students in learning Mathematics is a nationwide problem (Ozerm, 2012).

Before I portray research problems related to learners-friendly mathematics pedagogy, I feel the need to discuss what it means to be students' friendly pedagogy. Borrowing the idea from the student-centred approach of learning, I would like to assert that pedagogy becomes friendly to the students if it makes a room for students' autonomy, dependence, engagement, and their active participation in the learning process (Arman, 2019). While doing so, the students learn depending upon their prior experience and the learning opportunities available to them. As to the constructivists, the idea of friendliness in the learning process encompasses the connection between the prior experience of the students and the target learning items. Similarly, it also focuses on designing learning activities for new learning experiences in association with the

students' age, interest, needs, autonomy, and capacity for engagement and participation (Danya et al., 2019). In the context of this research, students-friendly mathematics pedagogy along with its curriculum and assessment systems refer to the methods, techniques, strategies, and learning activities designed with respect to students' interest, needs, autonomy, and prior experiences. If the approach of learning in a mathematics classroom supports students' needs, interests, and experiences, they are encouraged to participate intensively in the learning process and, thus, they get enhanced opportunities to learn.

As to my experience in teaching and learning mathematics in the educational institutions in Nepal, it appears to me that most of the classrooms are guided by a teacher-centered perspective, in which knowledge is transmitted in very strict and fixed ways being controlled by the teacher (Gill & Kusum, 2017). In this form of pedagogy, the teachers are only source of knowledge and they mainly use a chalk- and- talk approach while delivering the content; whereas students are seen as the passive listeners (Thapa, 2020). The learning styles, instructional methods, mathematics achievement levels, and confidence in doing Mathematics affect the learning of Mathematics in the classroom. Teaching techniques unfriendly to teachers often resulted in lower learning achievements on the part of the students (Sloan et al., 2002). Students take Mathematics as a difficult subject. At school level, I learned Mathematics in Nepali language, because of which it was difficult to understand the mathematical letters, formulae, signs, and symbols. Some students were from such ethnic communities where they learnt a local language which did not help them to learn the problems of mathematical words. The situation as such caused me raise problem such as whether the perception of the teachers and students towards Mathematics is

unhelpful and that being under the impression of such unhelpful perceptions they happen to engage with this subject in the way that creates a circumstance for them to be an underachiever.

At the same time, I also challenge this idea in a different way. Since Mathematics is used in almost all endeavours of life (Maina, 2010), teachers are supposed to know the rationale behind teaching Mathematics in a school. This context prompts me to raise a question: In what ways does mathematics pedagogy in the community schools contribute to enhancing students' learning experiences in Mathematics? It is often claimed that not only the perception but also some other kind of obstacle such as an unhelpful pedagogy caused a room for the students to be under-achievers in Mathematics. It also hit my mind with raising the question: how can Mathematics pedagogy be made learners-friendly? Since these problems cover a larger area of schools throughout the country, it requires separate academic research. I, thus, initiated this research to respond to these problems.

### **Purpose of the Study**

Based on the problem statement, I aimed at exploring teachers' and students' narratives of their experience towards making Mathematics learners-friendly in the secondary level.

### **Research Questions**

Based on my research problem, I developed the following research question:

1. How do teachers and students narrate their experiences about the ways to make mathematics pedagogy learners-friendly?

### **Rationale of the Study**

This research was justifiably important for many reasons. It helped me, as a Mathematics teacher, to understand and identify the areas and/or the conditions that made my students and myself, as a mathematics teacher, understand and identify the ways of teaching and learning Mathematics to make it learners-friendly. Since education is to impart as per the need and interest of the students (Baral, 2020), the finding of the research would be helpful in re/shaping and re/managing mathematics classroom in line with the students' needs and demands. Outcomes of the study would be useful, mostly for the people working in the field of education, namely teachers, curriculum developers, students, experts, policy makers etc. as well as the people related with the field of education e.g., parents, social workers, etc. The study would also contribute to broadening the existing body of knowledge, especially on the area of teaching and learning Mathematics giving a special focus on stakeholders' perceptions and practices. It would help the HTs and SMCs to understand the existing situation of teaching-learning Mathematics in the secondary schools and how the teachers and students narrate teaching-and learning of Mathematics to make it learners-friendly. For which, they will take initiatives in advance to manage the classrooms for teaching and learning of Mathematics.

Learners-friendly classroom, learners-friendly school environment, and learners-friendly pedagogy are different but interrelated terms. Some scholars (Sakata et al., 2021) advocate for learner's friendly classroom; while some other insist on learners-friendly school environment. But they often miss to recognize the role of techniques, methods, approaches, student-teacher relationship, learning materials, etc., as a part of learners-friendly pedagogy which plays vital role in promoting students' participations, inclusion, and learning performance, especially in the mathematics

classroom. To respond the pedagogical issues in the Mathematics classroom, especially those which often create distance between learners' requirements and their learning performances, this research has brought empirical evidences to claim learners-friendly mathematics pedagogy as a holistic approach in the field of teaching-learning Mathematics which integrates the physical, social, and technical aspects of learning together to make it friendly to the target learners.

### **Delimitations**

This research was limited to the public schools in Lalitpur District of Nepal. Each public school under this research was selected from Mahalaxmi Municipality, Lalitpur. Only the mathematics teachers teaching in grades IX and X were selected for interview. Only male mathematics teachers were selected for the research, as there was no female mathematics teacher available at the time of this research. SMC and parents were not reachable because of the spread of Covid-19. They therefore were not included in the research.



## CHAPTER II

### LITERATURE REVIEW

This chapter includes a review of relevant literature. Since my research agenda is learners-friendly mathematics pedagogy, I include contextual, theoretical, pedagogical, and empirical reviews related the research agenda. I also include the research gap and theoretical framework of the research in the end.

#### **Conceptualizing Pedagogy**

Pedagogy refers to the science of teaching. That is, teaching is a science because it follows a specific procedure to be accomplished in a systematic order. Pedagogy responds to the question: How do students learn? In this sense, pedagogy in the context of this research is taken as the method of teaching. Such methods are based on theory and practice. Different learning mechanisms are used while performing pedagogy in the classroom. Pedagogy takes place in a particular classroom setting and culture which are interlinked with the course/syllabus to be delivered. The purpose of pedagogy is to build up students' knowledge as specified in the subject of learning and curriculum. Based on such knowledge, the learners perform their activities in life and/or solve problems that they possibly come across in life.

The ways of ensuring learning on the part of the students are many. In teacher-centered pedagogy, learning is ensured on the part of the students by the active participation of the teachers. The learning contents are delivered by teachers in the classroom and the students follow their teachers' instructions. Once the teachers' instructions are followed, the learning is supposed to have taken place. Teachers in such pedagogy present learning contents which are included in the course syllabus.

The teachers and the students interact in the classroom only based on the learning contents. Teachers explain the lessons and the students listen to their teachers or they record the lecture in their exercise book.

On the contrary, student-centered pedagogy focuses the students' age, interest and ability to learn a particular lesson. In this kind of pedagogy, students are supposed to be more active in the process of learning. The role of teachers is to support the students by creating learning environment, by making learning materials available to the students, and by showing the direction to move ahead on the way to learning. In this kind of pedagogy, students are kept in the centre and all the other components are ensured in line with the students.

Constructivists' approach of pedagogy allows students active in the process of acquiring new experiences and/or knowledge. In the collaborative approach of pedagogy, the learners' groups are formed. They interact together to develop a strategy to solve the given problem. They develop a learning strategy by themselves to accomplish a given task. Integrative approach of pedagogy creates an environment where the learners connect or integrate themselves with the environment where they get the classroom, teachers, peers, textbooks, curriculum, syllabus, learning materials, learning contents, etc. Learning in this pedagogy means internalizing the contents by integrating oneself into the context. Reflective pedagogy on the other hand allows the students to observe the classroom activities and/or events performed by their teachers and peers. They then are asked to make meaning of those activities in terms of what, why and how questions. Inquiry based approach in pedagogy encourages the students to develop the sense of exploring new ideas related to the learning contents.

On the whole, I conceptualize pedagogy as a science of learning. Such understanding upon pedagogy helped me to observe, analyse and interpret the

pedagogy that were in practice in the mathematics classroom in the context of this research. While doing so, I observed pedagogy in the mathematics classroom with the lens of teacher-centred, student-centred, constructivist pedagogy, collaborative, integrative and reflective pedagogy.

### **Learning in Mathematics Classroom**

Learning in the context of this research is the developing mathematical sense and/or acquiring knowledge related to Mathematics. That is, how the learners make sense of Mathematics in relation to world in which they live. The way they use their mathematical knowledge to support their daily life activities can also be taken as learning of Mathematics. Learning can be interpreted differently depending upon the different perspectives. For example, behaviourists claim learning as a behavioural change on the part of the learners. Based on this perspective, learning is a outcome of connection between stimulus and response. In the case of learning Mathematics, the learners require to practice solving mathematical problems much until it becomes the part of their knowledge. According to constructivists, learning is the outcome of the learners' active participation and intense engagement in the learning activities. Learners make meaning of the world based on their mental state and/or cognitive ability. Social constructivism, on the other hand, supports learning Mathematics in social context especially through collaborative works in the Mathematics classroom.

This understanding on learning Mathematics helped me to internalize the ways of Mathematics mentioned in the Mathematics pedagogy literature. This also helped me to identify what kind of leaning is in practice in the context of this research in Mathematics classroom and how the existing practice of mathematics learning does or does not appear to be learners' friendly.

### **Mathematics as Cultural Knowing**

In this part of literature review, I would like to connect Mathematics with the culture of the learners in which I revealed knowing Mathematics as knowing culture and vice-versa. The purpose of connecting Mathematics with the culture of the learners is to explain the cultural dimension of Mathematics and its influence over the daily performance of the learners. In my opinion, learners in my study sites belong to a particular culture. For me, if mathematical knowledge is integrated with the culture of the target learners in my study sites, it was established as part of culture; and knowing of which becomes easier.

On the way to discussing *Mathematics as cultural knowing*, I would like to reveal the meaning of ‘culture’ in the context of this study. In this regard, I would like to get support from Wilder (1981), who claims culture as a “collection of customs, rituals, beliefs, tools, mores, and so on, called cultural elements, possessed by a group of people who are related by some associative factor (or factors) such as common membership in a primitive tribe, geographical contiguity, or common occupation” (p.7). I am, thus, convinced to see Mathematics as an ingredient of customs, rituals, tools and mores of the learners. While inquiring about making mathematics pedagogy learners-friendly, I saw how cultural knowing, that is, the knowing of customs, rituals, tools and more contribute to learning Mathematics and vice-versa.

In this context, a question of this kind seems relevant: How does Mathematics influence customs, rituals, tools and mores of the learners? The idea of economic determinism propounded by Marx seems to respond to this question. If I assert economy as the measure of all sorts of realities, be it social, cultural and moral, I mean that the customs, rituals, tools and mores of the learners are reinterpreted in terms of mathematical behaviours. For example, the choice of dress as a part of

customs among the learners in my study sites may be determined by their economy, which is often calculated in terms of the mathematical behaviours. The shape, size and the quality of cake bought to celebrate a birthday-a cultural ritual of learners in my study sites may be determined in terms of mathematical calculation of their economy.

Cultural tools can be conceptualized in terms of material and psychological viewpoints. While inquiring about learners-friendly Mathematics pedagogy, I observed what cultural tools the learners in my study sites are equipped with and how such cultural tools become useful in reshaping their mathematical behaviours. In my opinion, the target learners grow and live in the given socio-cultural context in which they are provided with some tools to make sense of the world around them (Robbins, 2005). Socio-cultural tools may be explained in terms of their material and psychological nature (Rogoff, 1995). The psychological tools under the given cultural context contribute to redirect learners' minds and behaviours, while the material or technical tools contribute to change the given context/objects (Daniels, 2001). I observe language, different kinds of numbering and counting, algebraic symbol systems, art work, diagrams, maps, drawing, etc. as cultural tools (Steiner & Mahn, 1996) to explain how the learners in my study sites can make meaning of Mathematics or develop mathematical behaviours through these tools. In this context, I see that learning Mathematics is, in a sense, knowing culture. I, thus, observed whether the Mathematics pedagogy in my study sites integrates such cultural perspectives to be friendly to the target learners.

### **Social Interpretation of Mathematics Pedagogy**

I interpret Mathematics pedagogy in terms of social dimensions of the learners. Such endeavour was useful in the context of this research in the sense that

the learners- being social creatures- often tend to learn in a socially approved way. The term 'social' in the context of this study refers to the groups of individuals who share the common interests and purpose (Simona, 2013). The socially approved pedagogy focuses on learning something through a defined relationship, participation, associations, and connections. It was therefore important for me to examine whether mathematics pedagogy in my study sites incorporates such social ingredients to make mathematics learning friendly to the target learners.

Cooperative learning strategy can be taken as one of the important ingredients to be integrated to the pedagogy of Mathematics to give social meaning to mathematics pedagogy. For Singh and Agrawal (2011), "Cooperative learning is the learning process in which individuals learn in a small group with the help of each other" (p.1). Cooperative learning, in this sense, seems to be a social approach of learning to be employed to enhance mathematical strength of the learners. If Mathematics pedagogy makes a room for creating various groups of the learners and thereby helping each other to make the meaning of their mathematical behaviours, it can contribute to enhancing the academic strength of the learners in Mathematics. Collaboration among learners in a team can be more meaningful if they work collaboratively (Laal & Laal, 2012). Collaboration as a part of cooperative learning can be a tool for making mathematics pedagogy learners-friendly. In a group, each individual learner knows the other in terms of their learning capacity, the level of understanding, and the ways of communicating effectively. They therefore can skilfully impart the learning items to each other. They can be both an effective teacher and learners at the same time. Since they share the common goal of learning Mathematics, they can best create a conventional goal to understand Mathematics and employ mathematical skills in day-to-day life. In such a way, enhancing mathematical

behaviours among the learners can be familiar and pleasing to the learners. In the context of my research, I observed how the elements of cooperation and collaboration are integrated into the classroom pedagogy of mathematics, especially to ensure mathematics pedagogy learners-friendly.

### **Review of Past Studies**

Mathematics pedagogy is often questioned in Nepal, especially because a large number of students are tagged with ‘underachiever’ in the School Education Examination (SEE) every year. Much research on the issues related to teaching-learning Mathematics has been accomplished. I have discussed some of them below:

Steiner and Mahn (1996) wrote a research-based article entitled *Math Anxiety in the Classroom* and stated the significance of learning Mathematics depends upon its employability in daily life. Mathematics can better be learned if it is taught associating it with daily life performances, careers, businesses, etc. Such a way of learning Mathematics promotes self-confidence of the learners and helps them grow up with the consciousness of Mathematics. On the contrary, their self-confidence is reduced due to math anxiety. Making mathematics pedagogy learners- friendly, thus, inspires them to trust their own capacity of learning Mathematics. In the context of my research sites, however, Mathematics teaching takes place without ensuring its connection with learners’ daily lives and that, in most cases, Mathematics is read, memorized without conceptualizing or understanding its application in daily life. As a result, Mathematics is felt as a difficult subject at school level. He provided some clues to make Mathematics pedagogy learners- friendly, such as creative thinking, active participation in problem solving, over correction of students’ attempts, etc.

Baulo and Nabua (2019), on the other hand, contributed to the epistemological, philosophical, and pedagogical worldview of Mathematics. He

explained Mathematics in the form of relative and absolute images which may play progressive or regressive roles in ensuring quality of learning Mathematics. The former accelerates Mathematics learning while the later may create math anxiety among the learners. For him, mathematics teachers need to maintain the balance between the Mathematics images, anxiety, and attitude, especially by adapting various methods of learning. I therefore learned that mathematics pedagogy can be made learners-friendly when it contributes to create positive and motivative learning experiences among the learners. Positive learning experiences in Mathematics can be possible when the Mathematics images, anxiety, and attitudes are duly handled while teaching-and learning Mathematics in the classroom.

Rawat (2018) carried out a research to identify causes of students' drop out. He explored several reasons in this regard such as, punishment in school, students' passivity, and boredom in the classroom, over domination of teachers on students, highly strict codes for students, learning as reciting answers of the questions, poor and unhelpful relationship between teachers and students, so on and so forth. These findings induced me to question whether learners-friendly Mathematics pedagogy would address these issues. For Rawat (2018), students' learning achievement is substantiated by some key factors: students' related factor, teachers' related factor, school related factor and home-related factors. I in this context encouraged myself to seek whether these factors have any roles in making Mathematics pedagogy learners-friendly.

Lower achievement in Mathematics is a burning issue not only in Nepal but throughout the world. A lot of studies were performed in the past focusing underachievement in Mathematics. Ozerm (2012) explored the rigorous training on the part of mathematics teachers would improve the students' learning achievements.



In another study, Eickelmann et al. (2017) claimed that lack of prior experiences in Mathematics pushed the students into the zone of under achievers. The new learning experiences in Mathematics are not duly connected with the prior experiences and hence the students are unable to make sense of the Mathematics lessons to be taught in the classroom. They are, thus, not able to use Mathematics experiences in their daily life appropriately. As a result, they appear to be underachievers in Mathematics.

Mathematics pedagogy is a worldwide issue and that it is a poor pedagogy which leads to underachievement on the part of the students. If the pedagogy is learners-friendly, it supports them to earn an excellent achievement. Ozerm (2012) in their study, explored that training helps teachers to up-to-date their way of delivering lessons as per the learners' needs and interests and thereby ensuring to make it learners-friendly. Eickelmann et al. (2017) concluded in his research that mathematics pedagogy cannot be learners-friendly if it is not connected with the previous knowledge of the students in Mathematics and that the learned mathematics behaviours must be associated with learners' daily life context. The finding as such encouraged me to scrutinize whether the mathematics pedagogy in my study context is connected with learners' previous experiences in Mathematics and whether learning Mathematics in the classroom becomes helpful for learners to address their mathematical needs in daily life.

On the whole, the above-mentioned research carried out so far in mathematics pedagogy informed me that several issues influence mathematics pedagogy in the classroom. These issues are connected to the school environment, family environment, students' own personality traits, teachers' personal and professional behaviours in schools, learning contents in Mathematics and their use in learners' life situations. While inquiring about making Mathematics pedagogy learners-friendly, I

observed how these issues come into play in the context of my study sites, especially while making mathematics pedagogy learners-friendly.

### **Constructivism as a Guiding Theory**

Learning has variously been explained by different scholars. Maria (2019) claimed that learning is the acquisition of new experiences in a given environment. But such new experiences are obtained by associating the previous experience of the learners with the new learning units (Martin, 2003). This gives me the sense that mathematics pedagogy can be learners- friendly if the teachers associate the learning items in Mathematics with the learners' previous knowledge and experience. This also helps me create an image that learning is the matter of mind which is an individually endowed phenomenon. Teaching of Mathematics can be made learners- friendly when the new learning unit in Mathematics is made a subject of reasoning, logical interpretation, and/or mental apparatus. Individual constructivism maintains that new learning is constructed on the foundation of the previous experiences/learning (McLeod, 2019). In this sense, learning is a mental process and, thus, mathematics pedagogy can be learners-friendly if it is connected with the processes that undergoes into the mind of the learners before the target learning takes place. The individual constructivism in the context of my research will be helpful to explain how the individual students interpret and articulate their past experiences related to mathematics pedagogy and how the same experiences appear to be un/helpful on the way to acquiring/constructing new knowledge and experience in learning Mathematics. Individual constructivism also helped me to explore the teachers' previous experiences on teaching- learning Mathematics and how their experiences contributed to connecting their own experiences of teaching Mathematics with the students' previous experiences.

Social constructivism, on the other hand, is another important theory in the field of classroom pedagogy. On the way to explaining learners-friendly classroom pedagogy I did not rigidly stick with individual constructivism but with social constructivism. As a researcher in the field of mathematics education and pedagogy, I interpret learning not only as an individual process but also a social process in which learning is constructed in the continuum of social interaction (Oldfather et al., 1999). On the way to explaining how mathematics pedagogy can be learners-friendly, I assert Vygotsky's (1978) idea which claims learning is to make meaning through sharing and negotiating socially constituted knowledge. By this I mean that mathematics pedagogy can be learners-friendly if it consists of social interactions as a method of constructing knowledge. For me, the students in the mathematics classroom represent the community/society in which they live (Williams et al., 2012). On the way to living and growing up in the community/society, they are endowed with the skill and process of being socialized in their community. Being socialized, for Maria (2019), is to acquire the social norms, values and the codes which are socially approved. When I equate acquiring knowledge and skills of Mathematics with the process of socialization, I understand pedagogy is a social process in which students are associated and exposed with mathematics experiences to make the meaning of being a part of the mathematics classroom. In this, mathematics pedagogy can be made learners- friendly if it is associated with the social way of knowing and valuing.

### **Research Gap**

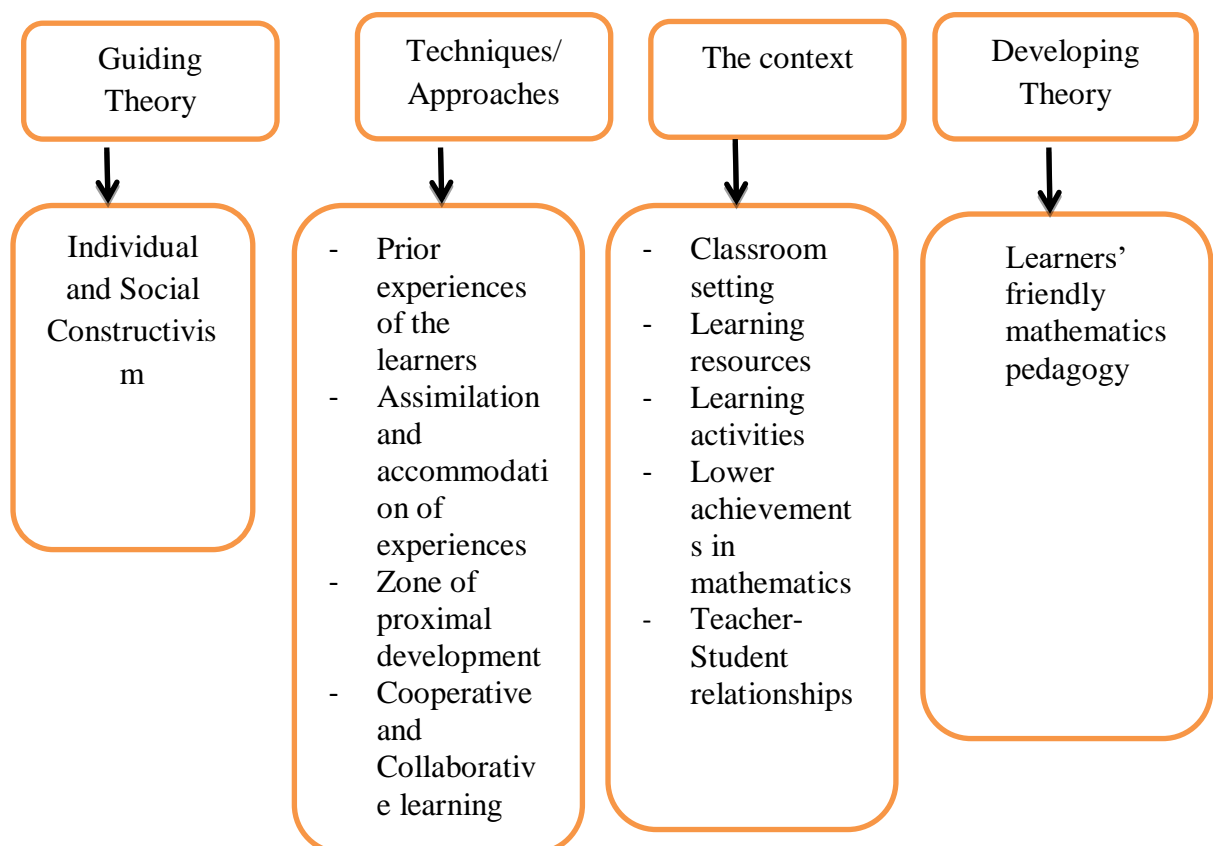
While reviewing literature I came to know that no literature (both theoretical and empirical) was available to claim student-friendly pedagogy, especially by

relating the issue of ‘friendliness’ in pedagogy on the way to constructing knowledge in Mathematics.

I also came to know that something which is compatible with learners' cultural and social setting becomes friendly to them. If mathematics pedagogy is made to be friendly to the target learners, it needs to be connected with learners’ social and cultural stances. The socio-cultural interpretation of mathematics pedagogy in the context of my study site is largely lacking. The key research gap in this context, as I observe is: how the mathematics teachers and the students in the context of this study are able to make mathematics pedagogy compatible with socio-cultural standpoints of the learners and how such attempts contribute to making mathematics pedagogy learners-friendly. I, therefore, attempted to fulfil this gap through this research.

### Theoretical Framework

The theoretical framework of the research is presented below:



Research on making mathematics pedagogy learners-friendly can be accomplished by considering the socio-cultural context of learners, setting of the mathematics classroom, learning activities, and methods. These components were further linked with and explained by individual and social constructivism. Students cannot remain aloof from their socio-cultural context. Their socio-cultural context influences their level of cognition (Salomon & Perkins, 1998). On the way to making mathematics pedagogy learners-friendly, teachers require to consider learners' prior experiences and/or their level of cognition with focus (DeJaeghere et al., 2021). Students' level of cognition contributes to selecting and performing teaching-learning activities in the classroom. Besides these, while setting a mathematics classroom, learners' age, interest, level of motivation, instructional design, learning materials, etc. plays a vital role (Sergei et al., 2019). Individual constructivism was connected with students' personal traits and social constructivism was used to explain students' social surroundings, either in the classroom or outside of it.

## CHAPTER III

### METHODOLOGY

In this chapter, I discuss the methodology I used to accomplish my study. The specific area where the study was conducted and the data collection procedures are described. I define my philosophical stance in terms of gathering, analysing, and using the field text/notes to reach a conclusion. I used a qualitative approach of research and narrative inquiry as a strategy to gather field texts/notes on the issues associated with this study. I also include the paradigm, methodology, data collection techniques, quality standards, and key ethical considerations of the study.

#### **Philosophical Considerations**

Under philosophical consideration, I considered ontology, epistemology, and axiology of my research, which I discuss in detail below:

#### **Ontology of My Research**

In the context of my research, I asserted interpretivists' stance of ontology, which convinces me that the realities related to mathematics pedagogy in my research sites are multiple in form (Slavin, 2014). Although mathematics appears to be a universal phenomenon as it is learned and taught in all public schools in Nepal, the way of teaching and learning Mathematics in schools differs depending upon the context of the teachers and students and the mathematics classroom setting. Such differences in the way of delivering mathematics lessons in the classroom create spaces for the existence of multiple realities related to mathematics pedagogy.

#### **Epistemology of My Research**

The epistemic technique to explore multiple realities related to mathematics pedagogy was subjective. In this context, I would like to raise a question- How did I

maintain subjectivity and in what ways the subjectivity remained helpful to meet my need of exploring multiple realities- to specify my epistemological standpoint in this proposed research (Creswell & Poth, 2016). To put the epistemology of my study into place, I focused on questions such as, “what do we know?”, “What does it mean to say that we know something?”, “What makes justified beliefs justified?”, and “How do we know that we know?” When I connected these questions with the multiple realities to be explored from the study sites, I felt my responsibility, as a researcher, to explore what my study participants would know about mathematics pedagogy. And, I also made it clear what might be the source of their knowing the reality that they claimed to have known. Connecting this notion of knowing with the constructivists’ epistemology, I followed individual constructivism to assert learning as a mental process, in which the learners learn a new thing or they construct a new meaning/reality stepping upon their previous knowledge and/or experiences related to the phenomenon (Brouneus, 2011). According to this epistemic technique, prior knowledge related to the teaching and learning of Mathematics and insights and reasoning capacity of the learners and teachers were supposed to be the key source of constructing new knowledge in the field of Mathematics pedagogy.

### **Axiology of My Research**

Depending upon my ontological and epistemological standpoints, as stated above, I prioritized the relative values which helped me to be context-specific on the way to uncovering the reality related to making mathematics pedagogy learners-friendly. The learners’ experiences were relative to their history, culture, and social surroundings (Luitel, 2009). Their experiences, thus, were laden with the values and priorities that emerged out of their historical, cultural, and social life world. In the context of this research, my participants’ narratives related to ‘making Mathematics

learners-friendly' was relative to their past experiences on teaching-learning Mathematics and the classroom environment in which Mathematics was learned and taught.

### **Approach of the Study**

I adopted a qualitative approach to accomplish this study for various reasons. First, my ontological, epistemological, and axiological claims asserted multiple realities, subjectivism, and relativism respectively, which could only be maintained duly through the qualitative research approach. In this approach, I explored multiple experiences on making Mathematics learners-friendly through the subjective perceptions of my research participants, especially by relating their subjective ideas with the context in which they learned Mathematics (Fisher, 2016). Second, this approach of study provided me space to narrate an in-depth account of emerging ideas in the field of Mathematics by making it learners-friendly (Thorpe & Holt, 2008). Third, as a qualitative researcher, I performed an instrumental role in all phases of research (Angelika et al., 2015), ranging from identifying research agenda to evolving conclusion, especially by being fluid, recursive, iterative, and evocative of the web-like complex phenomenon, which are likely to cover the vivid context of making mathematics pedagogy learners-friendly (Harreveld et al., 2016).

### **Research Paradigm: Interpretive and Critical**

My research design was in line with my research paradigm. That is, I constructed my research design in such a way that paved the way for me to explore multiple realities, out of the subjective experiences of my research participants. For it, I employed a qualitative research approach asserting the principle of interpretivism. Unlike post-positivism, which focuses on finding out facts and figures related to the research phenomenon by using statistical tools and techniques (Maina, 2010), a



qualitative research design under interpretivism helped me to construct reality related to making mathematics pedagogy learners-friendly by making the meaning of my participants' opinions and experiences. Aligning with the idea of Cohen et al. (2007), I realized that the opinions and experiences of my study participants in relation to making mathematics pedagogy learners-friendly cannot be measured statistically, so they were narrated, discussed, and interpreted in relation to the socio-cultural context in which they taught and learned mathematics.

While conducting research in line with interpretivists' worldview, I employed a descriptive and explanatory approach to give a detailed account of participants' experiences, feelings, understanding, and the ways they interpreted the existing nature of mathematics pedagogy and the way of making mathematics pedagogy learners-friendly (Cohen et al., 2007).

I, however, did not only stick with only an interpretive way of discussing mathematics pedagogy in the classroom. If I did so, I would have to be limited with the status quo and the taken-for-granted form of knowing and practising mathematics pedagogy (Pham, 2019). Viewing interpretivism in line with Holtzman (2014), I learned that this research design would help me in making sense of the existing conditions and practices of mathematics pedagogy. Since the purpose of research was not only to make sense of the existing nature of mathematics pedagogy but also to generate and/or pave the way out to make mathematics pedagogy learners-friendly, interpretive research design was only partially supportive. This approach did not pave me a way to explore a transformative way of understanding and practising mathematical pedagogy so as to make it learners-friendly (Riyami, 2015). I thus also employed some norms and principles of critical research design, in which I questioned the existing practices of mathematics pedagogy and the ways of knowing

and doing while performing mathematics pedagogy so as to make it learners-friendly.

### **Nature of Inquiry**

I followed narrative inquiry to accomplish this study. My choice of employing narrative inquiry depended on various reasons. First, every individual in the research site had their own story about the teaching and learning of Mathematics. Narrative inquiry paved the way for me and my research narrates their stories of experiences (Lyons & LaBoskey, 2002). It provided me with a rich framework to uncover how their stories of experiences depicted their way of understanding and learning Mathematics, and also playing roles in making mathematics pedagogy learners-friendly (Webster & Mertova, 2007). This nature of inquiry helped me to focus on complexity and perplexity, if any, the teachers and students faced on the way to making mathematics learners' friendly (p. 1).

Thus, narrative inquiry can be described with its two component parts: The first is narrative, meaning the story being told (Riessman, 2008); and second is inquiry, representing a systematic examination or analysis using narrative as a research methodology means to study the ways humans experience the world and how they make meaning out of their experience.

For example, the narrative of participants consisted of the setting in which they participate in teaching-learning Mathematics. Such experiences comprised the historical disposition of learning Mathematics. It also revealed how their experiences of participation in the teaching and learning of Mathematics contributed to making Mathematics learners-friendly. Their narrative revealed how the existing nature of teaching-learning Mathematics was in/sufficient to make it learners- friendly and how the existing practices of teaching-learning Mathematics could be improved to make it learners-friendly.

### **Research Site, Participants, and Sampling Procedure**

I selected two different public schools in Lalitpur district. I selected those public schools of the Lalitpur district where I engaged sometimes before as a teacher and also as an education development worker. The reason behind selecting those schools was that these schools were familiar to me which benefitted me to develop a strong rapport with the mathematics teachers, headteachers and students. mathematics teachers and students studying in grade IX and grade X, were my study participants. mathematics teachers were selected as the study participants as they were supposed to be one of the focused stakeholders and/or practitioners of mathematics pedagogy. However, I did not include members of the School Management Committee and parents because the spread of Covid-19 was at its peak and I could not reach them at their home. The participants provided me with the way they taught Mathematics in the classroom and also about the way they felt that their ways of teaching Mathematics were (not) learners-friendly. On the way to uncovering the ways of making mathematics pedagogy learners-friendly, the opinions, insights, experiences, and perceptions of the mathematics teachers of the selected schools were more helpful.

I selected those participants purposely ensuring that they would participate in the research activities actively and enthusiastically (Fraenkel et al., 2012). I would not have been able to generate rich and thick descriptions about making mathematics pedagogy learners-friendly without their active participation. I therefore ensured how informative they were and to what extent they would be able to contribute to the research in providing the required information. In choosing mathematics teachers, I did not have any option to choose more than one because there was only one teacher (appointed by the government) for teaching Mathematics in grade IX and X. But I was selective in choosing the students. While choosing the students, I ensured an

equal participation of both male and female students. Maintaining gender equality in choosing the students was helpful in exploring the perspectives of both male and female students in making Mathematics pedagogy learners-friendly. For choosing the potential students, I took help from the teachers and head teacher of the schools. All four mathematics teachers selected from the four different schools were male; while two students (one male and one female) were selected from each school and, thus, the number of students' participants was eight, i.e., four male and four female students.

### **Participants' Profile**

I would like to mention the details of my study participants below:

#### **Teacher 1**

Teacher 1 was a secondary school mathematics teacher. He had been teaching Mathematics for the secondary level students in the school for about 12 years. He completed Master's degree majoring Mathematics from Tribhuvan University. He was a permanent teacher in the school. He accomplished Teachers' Professional Development training. He also participated in various training program related to mathematics teaching in the secondary classroom.

#### **Teacher 2**

Teacher 2 was another participant in my research. He was about 55 years old. He was a mathematics teacher cum assistant head teacher of the school. He reported that he held the position of academic in-charge of the school. I contacted him through one of my friends. It was a school day. My friend took me to the school and introduced me to Teacher 2. While introducing myself with him, I explained the purpose of my research and the support I expected from him. I held my first day conversation with Teacher 2 in his own office. After hearing me, he agreed to provide me time for the interview. But he

called me the next day. I held the interview with Teacher 2 two times in which he also emphasized on classroom arrangement to make mathematics pedagogy learners- friendly.

### **Teacher 3**

Teacher 3 was a 55 years old secondary school mathematics teacher. He held 25 years of experience in teaching Mathematics in the secondary level. He was a local dweller. That is, he lived in the area where the school existed. Besides teaching in the school, he also, as he said to me, taught Mathematics for secondary level students in some coaching centres. He was a permanent teacher in the school. He accomplished Teachers' Professional Development training. He also claimed that he got an opportunity for TOT training.

### **Teacher 4**

Teacher 4 was a secondary school mathematics teacher. He taught in a school which was located in Mahalaxmi Municipality. He was of 49 and had accomplished his master's degree majoring Mathematics from Tribhuvan University. During the interview, he told me that he had had 17 years of experiences in teaching Mathematics in the secondary level. Besides this, he had completed his TPD training course a year ago. He also claimed that almost all students in Mathematics from his school would pass the grade 10 exam (SEE) every year.

### **Student 1**

Student 1 was one participant of this study. She was studying in grade 9 in one of the secondary schools selected for this study. She had crossed 15 years of age. According to her, she was a regular student in the class and that she often brought more than 75 marks (out of 100) in the exam of Mathematics.

**Student 2**

Student 2 was another participant of this study. He was studying in grade 10 in one of the secondary schools selected for this study. She had crossed 16 years of age. According to him, he was a regular student in the class and that he often brought more than 80 marks (out of 100) in the exam of Mathematics. He got sufficient time for self-study and that his parents hired a mathematics tutor for him at home.

**Student 3**

Student 3 was one of the participants of this study. During the interview, she stated that she studied in grade 9. She was 15 years old. She told me that she never got pass marks in Mathematics. According to her, right from the lower grade she never succeeded in Mathematics. However, she was promoted to upper grade hoping that she would improve her Mathematics later. Besides her studies at school, she had to engage in domestic chores, especially in kitchen helping her mother in cooking in the morning and in the evening. According to her, being a shopkeeper, her mother intensely engaged in shops in the morning and evening and hence she had to work in the kitchen at home. She, therefore, did not provide the required amount of time for self-study.

**Student 4**

Student 4 was one of the participants of my study. He studied in grade 10 in a secondary school of my research site. He had reached his 16. He belonged to Dalit family. He was the only son in the family. His parents were farmers. He studied in the same school from grade V. He claimed that he never failed in Mathematics in any grade. But he also said that he never secured better marks

in Mathematics in any grade. He told me that he hardly got more than one or two hours for self-study at home. According to him, Mathematics teaching very often appeared to be unintelligible for him. In this case, as he said, he consulted other students (especially those who knew Mathematics better than him) in the class to learn Mathematics.

### **Data Collection Tools and Techniques**

Based on my research question and research design, I developed open-ended questions for both teachers and students under this research. The purpose of using open-ended questions was to provide the research participants opportunities to narrate their experiences and opinions related to research agenda length and breadth. The open-ended question made the room for exploring the multiple potentials and in-depth understanding of the research participants. It also provided me opportunities to create emergent questions during the interview to explore all probable components and evidences to make mathematics pedagogy learners' friendly.

I used interview as a technique for generating information from the study participants. In-depth interviews were carried out for teachers and students. The interviews were conducted in the natural setting so that the interviewees would feel comfortable to participate actively in the research process (Showkat & Parveen, 2017). I used open-ended questions during the in-depth interviews so that the participants could receive an opportunity to narrate their experiences related to mathematics pedagogy and the ways to make it learners-friendly far and wide. During the interviews I asked, first, simple questions so that the participants could feel easy and comfortable to answer. Slowly, I asked some probing questions leading them to answer or uncover their complex ideas related to mathematics pedagogy. The simple questions in the beginning, as I felt, encouraged the participants to get ready to

involve themselves a little longer in the interview. In this way, the interview process was simple-to-complex so that the ideas related to making mathematics pedagogy ranged from a simple level to complex circumstances.

It was September 24, 2021; I was in search of a public school in Lalitpur. For this, I met a school teacher who was teaching in a public school. I introduced him with the agenda of my research and asked him to support in it. In reply, he asked me to come to his school to meet the maths teacher. He provided me with the contact number of the maths teacher and asked me to contact him in advance. I contacted the maths teacher on cell phone and then explained to him the purpose of my research. I then requested him to provide me with his valuable time for my research. He allowed me to hold an interaction with him in the school. For this, he fixed 1:30 pm. Next day, I reached his school and met him. He then took me to the headteacher of the school. I introduced myself to the headteacher and I also explained to him the purpose of my research. In the end, the headteacher agreed to hold the interview with the maths teacher. The maths teacher then took me to a meeting hall of the school. It was a long hall equipped with chairs, tables, projector, smartboard, etc. I sat on a chair next to the maths teacher. I then asked him to explain about his personal-professional background. In the same way, I approached all the other teacher-participants. I could not finish it all in a day. It took me rather about a month to visit the schools time and again, contact the teacher-participants and hold interviews with them. I visited one teacher more than two times. In the first visit, I collected some general understanding on making mathematics learners' friendly. But, later on, I became more specific to the sub-components of the research agenda. I recorded their opinions, experiences, evidences and illustrations in an exercise-book. I also recorded the interview electronically. I reviewed each interview note in the evening and derived some key



questions to ask them next day. In this way, I discussed with them on the research agenda until I found them repeating their experiences. Meanwhile, I also interviewed the students. The students' narratives were, to some extent, linked with the teachers' narrative. In that case, I verified students' opinions with that of the teachers' participants. In the end of every interview with either teachers or students, I thanked them and I also told them that I would consult them again as/when necessary until the accomplishment of the research.

### **Data Analysis and Interpretation**

After coming back from the study sites, I arranged the data in line with the questions which was asked during interviews. More specifically, while analysing and interpreting the narratives I considered four basic elements: coding, categorising, patterning and thematizing (Cohen et al., 2007). By coding, I identified concepts from the raw data through multiple coding processes. By categorizing, I linked codes to create a unit or category. By patterning, I identified repeated units (pattern) from the given categories. By thematizing, I created themes representing similar patterns. I then wrote each theme as a sub-heading to respond to each research question and under each sub-heading, I put the narrative in place as evidence. I then discussed the narrative, relating it with the given context, theory, other relevant literature, and my own reflexivity (Creswell, 2003).

In a sense, I began to analyse field narratives right from the initial interaction with the study participants and I continued it until I reached finding. I did not consider all the pieces of participants' opinions as they appear during interview. Some of the pieces of narratives were not connected with the research agenda. I assessed the data by asking myself a question: How can I make sense of the information provided by my study participants? In general, I followed some key steps

on the way to analysing and interpreting the field narratives. I examined the information and compared the prior information with the new one. I also consulted field notes to substantiate the newly emerged opinions during analysis and interpretation. Right after entering into the study sites, I got my insights developed gradually. The more I interacted with the study participants, the more I got my insights related to the research agenda sharpened. Such insights helped me a lot during analysis and interpretation of the participants' narratives. I connected my such insights with the particular piece of information during analysis and interpretation, which appeared to be my reflective opinions on the participants narratives. Such reflections appeared to be the part of meaning-making process in the context of this research. I however was aware whether my personal feeling, opinions, values, etc. would creep into the process of data analysis and interpretation.

### **Quality Standards**

The conventional methodological criteria of quantitative research were not directly applied to this study because of different frameworks, sampling approaches, size of samples, and purpose of the study (Slavin, 2014). I used three specific criteria to maintain the quality standards for this study. These criteria are described along with the subsequent sub-headings.

#### **Trustworthiness**

Trustworthiness is an important criterion for every qualitative research. For this, I engaged with the participants for a long time to collect all the related information. This helped me to understand and explore their experiences in depth. The aim of trustworthiness in a qualitative inquiry is to support the argument that the inquiry's findings are "worth paying attention to" (Lincoln & Guba, 1985, p. 290). Additionally, honesty and transparency about researcher's biases, and faults play a

crucial role (Cropley, 2021). Hence, sincerity is another vital issue while addressing quality issues in a qualitative research. To maintain the trustworthiness of my research, I interviewed the participants more than one time. I also considered credibility, transferability, and dependability under trustworthiness which were duly considered as the measure of quality standards in a qualitative research.

By the term credibility, I understood that the results of the qualitative research are credible or believable from the perspective of the participants in the research (Cherry, 2020). I, thus, collected text and information which was sufficient for the cross- verification of the information. It was done based on the document analysis and in-depth interview. In this regard, I used personal notes, reflective notes, and theoretical notes in each interview (Shenton, 2004). Similarly, I maintained a thick description of the data and information to make the meaning rich. Transferability is the external validity of research findings (Guba, 1981). From the qualitative perspective, transferability is primarily the work of generalizing the meaning in a similar context (Shenton, 2004). For that, I used interview guidelines for emergent questions. I enhanced transferability by describing the research context thoroughly.

Dependability is closest to reliability. Normally, it assumes of replicability or repeatability (Lincoln, 1995). I was mindful that information was not repeated time and again. I also examined the extent to which the operations of a study could be repeated with the same results or to what extent this was possible in the study of similar kind.

### **Authenticity**

Authentic field text/notes and literature would make my research plausible (Creswell, 2009). I, therefore, used only such field text/notes that helped me explore authentic and real experience of the participants. I used polite language with the

participants while collecting the field text/notes. I talked less and empowered my participants to talk in the in- depth during interviews. I did my best to respect myself and my participants. I documented the procedures for checking and rechecking the data throughout the study. Similarly, I actively searched for and described the data audit that examined the data collection, analysis procedures, and making judgments about the potential for bias or distortion.

### **Standpoint of Empowerment**

Standpoints of empowerment included entitlements, rights, responsibilities, preparedness of action, and critique of self and other (Karen, 2017). The participants were able to know the role, contribution, power and responsibilities of the mathematics teachers and were critical towards their rights, actions, and responsibilities. I, thus, addressed the quality issue with the help of three criteria mentioned above. I paid an effort to ensure that the research employed quality measures through the processes like: the extension of research process over a period of time that was sufficient to reveal the phenomenon, peer debriefing, use of other texts and artifacts, member checks, enhancement of verisimilitude through proper contextualization, consistency in the process of field text/notes collection and meaning making; proper documentation and recording of the responses of the research participants (Shenton, 2004); and finally, I went through a rigorous process of qualitative inquiry. This included thick description and metaphoric narration during reporting and use of the literature.

### **Ethical Issues**

All ethical principles are based on esteem for human beings and their experiences which reduce harmful practices in research (Orb et al., 2000). It serves to keep the pride, rights, wellbeing, and safety of every research participant. In addition,

it shows the behaviour of high-quality research that offers benefits and advantages to the research participants and the wider area (Creswell, 2003). I selected a few ethical issues in my study like moral permission, recruitment of research participants, informed consent, and duty for respect (Creswell, 2003). I took prior permission to conduct research. I ensured the participants that the confidentiality and anonymity of their identity were maintained through the removal of any identifying characteristics before the dissemination of the information (Raudonis, 1992). I ensured that the participants were not harmed and their involvement also benefited them. I tried my best to remain detached from such kind of emotions and biases during the period of my stay with the participants.

Finally, and most importantly, I made sincere efforts to remain honest while writing reports and reporting the field information in terms of information gathering and meaning making process (Punch, 1994). Thus, I claim that I could give fair justice to the research as well as the research participants. I respected my participants' views and their logical thinking as a part of ethical consideration of my research.

CHAPTER IV  
MAKING MATHEMATICS PEDAGOGY LEARNERS  
FRIENDLY: TEACHERS' NARRATIVES

In this chapter, I discuss teachers' narratives on making mathematics pedagogy learners-friendly. That is, I discuss how the teachers who worked as participants of my research perceived and explained the ways of making mathematics pedagogy learners-friendly. While narrating participants' opinions and perspectives, I developed the themes by addressing the research questions. The teachers shared their experience on teaching and learning Mathematics at secondary level classrooms. Finally, these themes were discussed relating to the theory and research questions and I discuss it through the meaning making process.

**Making of Learners-Friendly Environment**

Learners' friendly pedagogy has close connection with classroom environment. To put it differently, classroom environment in students' friendly pedagogy ensures maximum engagement of students in the learning process (Eickelmann et al., 2017). On the way to inquiring about learners' friendly mathematics pedagogy, different participants asserted the role of classroom environment in their own ways. In this regard, Teacher 1 said:

*Under the students' friendly pedagogy, the teacher makes environment in which one student, the one who knows, teaches the other, the one who does not know. The teacher also has to follow the students until s/he is able to solve the problem. It is also important under the students' friendly pedagogy to make such environment in which the students can ask the teacher without any fear and/or hesitation.*

In the above narrative text, my study participant opined classroom arrangement as the organizing, ordering, and sequencing the students in the classroom as per their competence (Acharya, 2020). Learners-friendly classroom pedagogy, thus, includes the harmony and balance between and among the students by their ability to learn (Arman, 2019). I, however, would like to ask a question of the kind: what does harmony and/or balance between and among the students in the classroom have to do to make mathematics pedagogy learners-friendly? With reference to the narrative text, harmony between and among the students contributes to ensuring conducive learning environment in which one student supports the others in solving mathematical problems in the classroom (Cheryan et al., 2014). In this context of researching, I inquired further with the mathematics teachers to explain what might be the bases of harmonizing, sequencing, and/or ordering students in the classroom to ensure learners-friendly mathematics pedagogy. In reply, teacher 2 said:

*It is also important to focus on classroom setting on the way to making mathematics pedagogy learners-friendly. The level of students in the classroom is different. Some students secure A+ and some others B+; there are still some other who score D and F grade in the exam. I categorize them according to their competence in Mathematics. For this, I provide them with a test. Terminal takes place in each three months. So, there is a long gap between two different terminal exams. So, I arrange for unit test/class test. The achievements of students in these small tests are analyzed. Based on that we observe them. That is, we observe their homework. We also observe how frequently they do homework and classwork. Based on their responses in homework and classwork we categorize them and, thus, the poor students are focused duly.*

Organization of students in the classroom based on their ability to learn is rather significant in making mathematics pedagogy learners-friendly (Acharya, 2020). However, the study participant emphasized that organization of students needs to be based on their ability to learn Mathematics (Danya et al., 2019). For example, as explained by the study participants in the narrative, some students are excellent, some are moderate and some others are poor in learning Mathematics. The sitting arrangement of the students in the classroom is made in the continuum of *good and poor* by their ability of learning Mathematics. While doing so, the poor students can learn Mathematics with the help of their fellows who are better learners in Mathematics. That also means that learners-friendly mathematics pedagogy creates learning spaces for both good and poor students, where the former students cooperate the later ones in learning Mathematics. For my study participant, good and poor students in Mathematics are separated based on their competence which is often determined through classwork, homework, project work, etc. in Mathematics. Additionally, highlighting the learners' friendly classroom setting, Teacher 3 said:

*Classroom arrangement is a primary component for making mathematics pedagogy learners-friendly. But the problem is that the number of students is increasing day-by-day in our school. There are 75 students (physical classroom) in grade 9 only. 38-40 students were participating in online class. The first term exam of grade 9 started from 10<sup>th</sup> of this month. The exam is being conducted in the physical classroom. All 75 students are attending the exam. There are 52 students in grade 10. The number of students is increasing here also. We are in the condition of dividing the class into two different sections. There is the matter of overload of work on the part of the teachers.*



As mentioned in the narrative, learners-friendly pedagogy in the mathematics classroom demands to focus the size of the class. The large size (75 students in one classroom) of the classroom often exerts an unmanageable pressure upon the teachers to contribute to making mathematics pedagogy learners- friendly. For the mathematics teachers under this research, learners-friendly pedagogy requires sufficient and excellent performance on the part of the teachers, especially in relation to planning and executing mathematics lesson in the classroom (Endang, 2018). The large size of the classroom, as claimed in the narrative, often intends to overload the teachers with works which does not make sufficient room for a mathematics teacher to create a conducive learning environment to make mathematics pedagogy learners-friendly. In this context of my research, I would like to question: How does a large classroom create problems in making mathematics pedagogy learners-friendly? In response to this question, Teacher 4 said :

*I would feel easy to arrange the classroom if there were 20-25 or maximum 30 students in the classroom. Sitting arrangement should be in U-shape or V-shape. But due to the increased number of students I have not been able to do so. Since the classroom is large, I have to move in each row and column of the students. But due to lack of space, I cannot visit each student in the classroom. There is a book corner in the classroom. It is in every classroom. I have kept objects related to maths in the classroom. Students are to be arranged in the classroom on the basis of their knowledge. For example, those who know Mathematics and those who do not know and/or are poor at Mathematics, these two different categories of students are to be mixed up in the classroom. This provides the poor students with opportunities to learn from those who know Mathematics. Besides these, sitting arrangement in the classroom create several possibilities. But a lot of hurdles are created on the way to*

*making mathematics pedagogy learners-friendly if there are a lot of students in the classroom.*

A small size of the classroom often remains manageable. In such a classroom, as claimed in the narratives, the mathematics teacher can organize the students based on their competence and also by their order of placement. For example, learners-friendly mathematics pedagogy requires learning activities to be performed in the classroom in which the students are to be organized in the order of their competence (Song & Kapur, 2017). The one who possesses better skills at Mathematics are often placed into the groups of those who know less of Mathematics. In such a group, a teacher needs to manage space, time, contents, and activities so as to ensure that all students have equal opportunities to learn. In such a learning environment, the better learners often cooperate and coordinate with the poor ones to help them promote their skills for solving mathematics problem (Laal & Laal, 2012). In the large classroom, these activities are rather difficult for a teacher and, thus, the pedagogy in the classroom becomes complex. In this context of my research, I asked Teacher 1 a question of the kind: What supports teachers to make the classroom conducive for mathematics learners? In reply, he told me that it is the use of ICTs that often helps the mathematics teachers to ensure learners-friendly pedagogy in the classroom. Highlighting the need and importance of ICT in making learners-friendly mathematics pedagogy, he said:

*The students are in the 21<sup>st</sup> century. There are increased voices for the use of technology in the classroom. Students are more advanced than teachers in ICT skills. It is therefore important for teachers to update themselves in ICT. I have attended about three dozen of training sessions on ICT from STFT since last year. I have also attended trainings on using ICT in mathematics classrooms. Such trainings are*

*provided to the teachers free of cost. I involved in the training realizing that I need to up-to-date myself. During the COVID pandemic, I learned how to make ppt slides.*

*A mathematics teacher needs to be updated on how to develop and find out the learning materials by using ICT. Students can be monotonous if they are taught giving lectures in the classroom. So, mathematics lessons are to be taught using ICT. I have not developed You-Tube videos. But a mathematics teacher needs to record the You-Tube video related to mathematics pedagogy. When teachers are absent, the students can be taught using You-tube. I demonstrate some You-Tube video in relation to maths in the classroom.*

*Teachers also need to be technology friendly so that they can use ICT in the classroom. Teachers also need to be able to use different apps to learn themselves and also to help their students learn Mathematics. We, teachers need to be updated; not out-dated. We cannot take our students to ICT room. Sometimes we have to teach the students using our own laptop. So, we need to be technology friendly. This is the time of smart board. If a smart board is kept in the classroom, it is more effective in making Mathematics pedagogy learners- friendly. The projector can also be helpful for making Mathematics pedagogy learners-friendly. Learners-friendly classroom needs to consist of textbooks and extrabooks.*

The need and importance of ICT in Mathematics classroom is universal. That is, both the teachers and the students feel the need of using ICT in Mathematics classroom. The roles of ICT in Mathematics classroom can be recognized variously. For example, ICT often support the teachers in introducing and delivering the complex learning items in an easy and legible way (Thapa, 2020). Use of ICT also contributes to motivating students and arousing students' interests to learn (McLeod, 2019). Teachers may use ICT in the classroom to create living images of the

mathematics lessons to be taught in the classroom (Laal, 2012). Use of ICT may also help the teacher to address the gap between the students' prior knowledge and the target knowledge (Thapa, 2020). For the reasons as such, use of ICT can hardly be denied in the mathematics classroom. Making mathematics pedagogy learners-friendly, in this context, requires knowledge, skills and attitude of organizing, selecting, planning and executing technologies on the part of mathematics teachers in the classroom (Murugesan & Santhirasekaran, 2021). Making mathematics pedagogy learners-friendly thus requires teachers' training on the part of the teachers and also the skills to use them in the classroom. In this context, both the teachers and the students need to be friendly to the use of ICT in the mathematics classroom. In this context, I asked my study participant whether use of ICT can be equalized with the use of learning materials: In reply, Teacher 3 stated the under-mentioned opinions:

*In child friendly pedagogy, the teacher needs to make arrangement of basic learning materials and ask the students to solve the given problem using those materials.*

*Sometimes I demonstrate paper cutting, paper folding, etc. For example, if I have to discuss cylinder in Mathematics, I carry a cylindrical shaped object in the classroom. A teacher has to ask the students in the classroom, "What materials are available in your house similar to this cylindrical object?" The teacher provides them with an opportunity to list down the name of the objects of spherical, circular shapes. This may help them be familiar with the given objects. I feel Mathematics teachers have to go ahead with this concept of pedagogy. I am also following the same.*

*It is important to ensure students' participation in the mathematics classroom. To ensure this, some learning materials to be used in the mathematics classroom are to be developed by students themselves. Some learning materials to be used in the*

*mathematics classroom can be collected by them. For example, I ask the students from grade 8 and 9 to develop cylindrical types of objects. Cylindrical types of objects can also be constructed. Cylindrical objects can be made by folding or rolling rectangular paper. Once I taught them and they were able to do so. Students could know how to make it. I then could teach them how to find of the area of the rectangular shape. We need to use our resources while training them. Learning materials need not necessarily be bought.*

*What I did and have been doing is that I make students develop learning materials. Many mathematical formulae are used in the maths classrooms depending upon the lesson. Therefore, I ask the students to write all the formulae in a chart paper. I then ask them to hang it on the wall. I also ask the students to cover the chart with plastic for its durability. I had made a mathematics corner in the classroom where I had kept 2/3 book cases. I kept there only mathematical instruments, learning materials that would be used in learning Mathematics in the classroom, extra practice book, etc. I ask the students to observe and use the equipment or materials related to the lesson. There is lack of room in this block. Since there is an increased number of students, we could not keep the Mathematics corner in the classroom. Mathematics classroom can be learners-friendly if there is a mathematics lab consisting of instructional materials, books, set square, table, chair, four walls and also if students are provided with opportunity to do practical as they do in the science lab.*

*Mathematics teachers need not only write on the board but learning by doing way of teaching can be a learners-friendly pedagogy. By this method, we can ask students to find out the area of four walls. We can also ask the students to visit the local shops to find out the selling price, cost price to learn about profit and loss in Mathematics.*

Learning materials bring liveliness in the classroom pedagogy. Learning materials in the mathematics classroom have got a number of functions. First, it is demonstrated in the classroom to construct the images of the lesson to be taught in Mathematics (Park & McLeod, 2018). Second, it gives the impression of a real-like environment in which the given lesson in Mathematics is used (Riyami, 2015). Third, construction of learning materials by students themselves help them develop an insight on how the mathematical formula, shape, size, ordering and sequencing work while fitting them with the given mathematical problems (Solheim et al., 2018). The availability and use of learning materials in mathematics classroom help the students compare and contrast how things in their home and school environment look like in relation to those available in the classroom. The skill of constructing learning materials in Mathematics provide them opportunities to learn how the given problem looks like and in what ways these problems can be solved by using them. The activities and opportunities as such available in the classroom do not only help them learn solving the mathematics problems but also develop an insight to interpret Mathematics as a life in itself which the students have to live with.

Constructing learning materials helps students be practical while using them in real life situations. It helps them to be practical in the sense that it contributes to bring about changes in their behaviour and relationships in their physical and social setting. It makes them exact in the sense that it encourages them to live with accuracy in terms of their behaviours and relationships. Use of learning materials helps the students increase the durability of learning (Takeuchi, 2015). That is, it makes learning experiences long lasting.

Selection, organization, and demonstration of learning materials require special setting in the classroom. Separating the corner for learning materials,

arranging the material case to demonstrate mathematical instruments, managing extra or reference materials, establishing Mathematics lab, etc. are some special efforts made by the mathematics teachers to ensure the learners-friendly mathematics pedagogy.

On the whole, I came across multiple meaning. First, the narrative convinced me that physical setting of classroom can play an important role in making mathematics pedagogy learners-friendly. The physical arrangement in the classroom contributes to localizing the learning materials, displaying and using ICT devices, participation of students in learning activities, deciding about an appropriate learning activity to fit with the lesson and also to fit with the students need, interest, and competence (Murugesan & Santhirasekaran, 2021). In recent years, the demand for inclusive classroom has increased. While observing the classroom with inclusive and social justice perspectives, the learners may be from a socially disadvantaged group, marginalized community, poor and handicapped. In this context, the classroom in question requires to address the need of all disregarding their caste, ethnicity, social positioning and physical in/abilities. The classroom setting must ensure friendly and protective environment where children with these diversities can learn equally well (Sharma, 2011).

As to the narrative performed by the teacher, the classroom setting also contributes to making mathematics pedagogy learners-friendly in the way that it consists of an environment where learners are dealt with individually depending upon their competence and/or level of performance. For my study participant, students are different based on their competence in Mathematics and that they perform differently depending upon their competence. In this context, for my study participant, using same techniques for all students in the classroom is not justifiable. That is, those who

achieve a higher grade in Mathematics may be taught using the techniques different from those who achieve a lower grade. Such a classroom context often convinces the mathematics teacher to categorize the students by their level of performance. Such categories often inspire the teachers to design a variety of learning activities that would best suit the individual students' competence (Rands, 2017).

In this context, I would like to raise questions of the kind: What do the variety of learning activities in the mathematics classroom have to do in making it learners-friendly? Why is it important to select, organize, and perform the learning activities so as to make them best fit to the competence of the individuals? I, as a researcher, considered these questions as a key to justify the role of learning opportunities available for students in the classroom and its connection with teachers' endeavor of making mathematics pedagogy learners-friendly. At this point of time in my research, I would like to borrow the idea from the student-centered learning approach. In this approach of learning, the students in question are centrally focused to help them bring about a change in their behaviour, as a part of their learning (Cheryan et al., 2014). Since the target students are different in terms of their age, attitudes, needs, interests, ability, etc. the teacher in question needs to develop multiple learning activities and provide the students an opportunity to learn on their own pace by participating in those classroom activities (Janna et al., 2019). For me, learning activities need to be designed aligning with the prior knowledge and/or experience of the learners so that they can associate the new learning items with their previous one and make the meaning of the world around according to their needs, interests, and socio-cultural boundaries (Gregory et al., 2019). While doing so, the learners can not only construct their own meaning of the world in which they live but also enjoy the learning process.



This is, as I see, exactly the space for the teachers, learners, and the researchers, like me, to claim that the mathematics pedagogy is learners-friendly.

While connecting my research with the 21<sup>st</sup> century pedagogy, I realize the role of Information and Communication Technology (ICT) in making mathematics pedagogy learners-friendly. Das et al. (2019) assert that ICT has brought such changes in the field of education that were hardly the part of imagination of the human kind in the past. As I connect the use of ICT for making mathematics pedagogy learners-friendly, I came across its significance in multiple ways. It may provide the teachers in question to demonstrate the technologically designed object and/or environment which functions as realia for the learners. It helps the teacher to bring the images of real lifeworld into the mental map of the learners through which they interpret themselves in association with the world in which they live (Jackson & Cho, 2018). The vitality of ICT as such seems to be an integral part of mathematics pedagogy if it is to be justified as the learners-friendly.

### **Learners-Friendly Techniques for Delivering Lessons**

Delivery of mathematics lessons require a number of methods, techniques or approaches depending upon the students' previous experiences in Mathematics, their needs, interests and ability (Sloan et al., 2002). Learners' friendly mathematics pedagogy can thus be assessed in terms of the methods, techniques or approaches used in the mathematics classroom. In this connection, I inquire the role of teaching-learning methods or techniques in ensuring learners' friendly mathematics pedagogy. Teacher 2, one of the study participants, in reply, said:

*I have heard immensely about student friendly pedagogy. The trend of teaching in previous days was teacher-centered. In this, teachers were more active in comparison of the students. But you are talking about learners-friendly pedagogy.*

*This means, learners are to be more active than the teachers, especially while performing teaching-learning activities. As I know, a learners-friendly pedagogy is based on the 'learning- by- doing' technique. The subject like Mathematics is highly connected with our daily life. This means, it can be made learners-friendly if the Mathematics lesson in the classroom is connected with the daily life stories of the children.*

For the participant, mathematics pedagogy can get the status of *learners-friendly* if they get opportunity to engage with some sorts of activities on the way to making sense of the mathematics lesson in question. The more extensively they engaged, the better and friendlier the pedagogy is supposed to be. In such pedagogy, the learners acquire the first-hand experience through their active participation in the classroom activities (UNICEF, 2020). According to the participant, the techniques entitled as *learning- by- doing* help the learners equip themselves with the knowledge and skills which does not only contribute to solve the problems given in the Mathematics textbook but also the problems related to Mathematics in their daily life. This seems that Mathematics demands an activity-based pedagogy which is harmonized with life stories of the learners. Highlighting the importance of *learning- by- doing*, Teacher 3, one of my study participants, said:

*We generally interpret Mathematics as a problem-oriented subject. This is our bad concept. Let's take an example. There is a mathematical formula. Based on this formula the students are asked to solve the problems given in the Mathematics book. First of all, we need to talk about the formula. How is it developed? Why is it useful? In what ways do they contribute us? Without discussing these, we directly start solving the problem. This is the trend.*

*In the context of this school, we discuss the basic status of formula before we start a new lesson. Whenever I felt time, I inform the students where the given mathematical formula came from. For example, if I teach the compound interest in grade 10, I provide them the basic understanding of the term 'compound' and 'interest'. In this way, I make them understand where the formula related to compound interest came from. I also make them understand how such formula and/or mathematical lesson is connected with my daily life. I encourage them to create a mathematical problem with reference to their own life. I then ask them discuss the problem in groups. I also help them use inductive/deductive ways of knowing Mathematics. I ask them to discuss following the principle of 'concrete to abstract.'*

For the study participant, Mathematics is not to be taken as problem-oriented subject in which students are habituated to solve mathematical problem given in the textbook. For him, such a way of interpreting Mathematics is monotonous and mechanical; but not a social, human, and lifelike process. It does not provide the learners to make questions against the given problem such as: why is this problem so as it occurs? What is the origin of the problem? What is its significance in life? In what ways knowing about solving such problems contribute to addressing mathematical issues in life? Unless the learners interpret such questions, they cannot feel the lesson or pedagogy conducive to them. In the traditional approach, as asserted by my study participant, students are provided with formulae in Mathematics, which they memorize and use the same while solving the mathematical problems given in the mathematics textbook (Takeuchi, 2015). Such a notion of pedagogy is to be challenged and replaced with the one in which the learners are trained how to generate the given mathematical formula by themselves. Such a pedagogy helps them interpret a mathematical problem in the text not as problem to be solved but a solution to be

demonstrated aligning with their mathematical issues in life. In the same vein, Teacher 2, one of my study participants, said:

*These days I focus on the thematic lab in a Mathematics classroom. In other subjects, grade 10 students have got a thematic lab but there is not any provision in Mathematics. The government of Nepal has realized it. It can also be taken as a technique for teaching Mathematics. Our school has got a practical marking system even in the mathematics subject from grade 9. You might have seen a lot of learning resources. It is difficult to get the learning materials to keep in the math lab. Budget was allocated to supply learning materials to the students. That is why, it is important to demonstrate new ideology, concept, feeling, etc. If these are done, mathematics pedagogy can be learners-friendly.*

For my study participant, a thematic lab and practical marking can have an important role to play in making mathematics pedagogy learners- friendly. The Mathematics laboratory is an essential learning space for the students of basic education as well as for early teacher education. In addition to the materials and physical space provided, it constitutes a proper space capable of promoting the reflection of future teachers (Oliveira & Kikuchi, 2018). A mathematics lab can be explained both as a place and as a procedure. As a place, it consists of mathematics related movies, textbooks, reference materials, mathematical tools such as abacus, geoboard, etc. Besides these, it also includes the digital technology such as computer and smart phone. The collection of mathematical equipment as such helps the learners engage themselves to work on a particular mathematical theme using appropriate equipment available in the mathematics lab. Their engagement may be individual and/or in a group. This seems that math lab is not to be taken just as the store house of learning materials but a space where the learners in question exchange their ideas and

mathematical practices demonstrating their engagement in intellectual and experimental tasks which are mathematically influenced (Solheim et al., 2018). The mathematics lab as a process provides the learners an opportunity to think, to raise question, and to identify a pattern and relationship which collectively help them create an image of mathematics inquiry (Webster & Mertova, 2007).

On the whole, my study participants agreed to ensure an active participation of the students on the way to making mathematics pedagogy learners-friendly. The idea of making learners active in the process of learning in the classroom has been asserted by many scholars, who maintain that learning can be ensured on the part of the learners only on the condition in which they are active in the learning process (Oldfather et al., 1999). The more they are active, the better the learning environment is supposed to be for them. A learners-friendly pedagogy, therefore, constitutes of an active and interactive performance of the learners. I, however, would like to question: what might be there that causes learners active in the learning process? In this connection, Zacarian et al. (2020) seems to be relevant who holds the view that it is the classroom environment that motivates the children in question to be an active learner in the classroom. This also means that a teacher needs to ensure a motivating environment in the classroom that necessarily encourages the children to be active in the classroom (Sharma, 2012).

What it is that makes the classroom environment encouraging? For my study participant, the classroom environment can be encouraging if it represents the daily life of the children in question. In the context of mathematics classroom, the teacher can manage those learning materials which the students come across in their daily life situation. For example, as my study participant asserted, the mathematics teacher in the classroom connects the mathematics lesson such as simple interest, profit and loss,

measurement, so on and so forth with the students' activities in the community and in the family, such as the domestic works they perform and economic activities that they involve in (Song & Kapur, 2017).

The deductive pedagogy in the mathematics classroom was strongly denied by my study participant. For my study participant, the deductive pedagogy in the Mathematics classroom is a formula-driven pedagogy in which the students are provided with mathematical formula and they are asked to solve the given mathematical problems by using the formula. In the mathematics classroom, as my study participant explained, the mathematics teachers, in general, often tend to provide the readymade formula and that they ask the students to solve the given Mathematics problem based on that particular formula. Such pedagogy cannot be learners-friendly since this method of teaching Mathematics does not provide the learners an opportunity to be active and creative. Thinking, reasoning, analyzing, synthesizing, reducing, expanding, comparing, and contrasting are some kinds of activities in the mathematics classroom through which the students realize the meaning of being a rational, intuitive, and creative creature (Thapa, 2020). The deductive pedagogy, as to my study participants, does not contribute to the learners to realize themselves as innovative and explorative.

On the contrary, for my study participants, the inductive way of learning Mathematics, where students get the opportunity to generate mathematical formula by themselves, creates opportunities for learners to be innovative, participatory, and also creates the space for their intense engagement. This is the way, for my study participants, to relate themselves with the world around in mathematical terms and feel the meaning of being a part of the world in which they live. That is, while explaining the mathematical formula, the teacher-participant provides the

opportunities to get familiar with the way of deriving formula. The target of the teacher-participant, as he said to me, does not remain to make students learn the origin of the formula but to explain the formula in solving the mathematical problems that they come across in their daily lifeworld.

For my teacher-participant, a learner-friendly mathematics pedagogy includes the availability of a Mathematics lab, provision for practical marking scheme, and availability and use of learning resources of Mathematics. The concept of mathematics lab, as to my teacher-participant, developed when he compared it with the science lab and the English language learning corner. According to him, a mathematics lab for the students has got an essential role to play in making the mathematics pedagogy learners-friendly.

### **Learners Participation**

Making mathematics pedagogy learners-friendly was explained by Teacher 3 under this study. He explained the below -mentioned ways of making mathematics pedagogy learners-friendly in which he emphasized the need and importance of learners' participation in learning activities.

*There has been a lot of changes in the method of teaching these days in comparison of the past. I have kept up-to-date myself accordingly. In the past, I entered the classroom. I solved 2 or 3 problems given in the chapter and then I asked the students to do the other problems. In that system of teaching, teachers only solved the problems on the whiteboard; and students would respond whether they understood. I used the question-answer method while teaching in the classroom. But at present time, the pedagogy is different. In the recent years, I have emphasized on the 'project work' technique. I did not use this technique before; yet I checked their homework in the past. But if the mathematics pedagogy is to be made learners-*

*friendly, the mathematical problems are not to be solved by the teachers only. The opportunity is to be provided to the students to assess or judge themselves whether they are right or wrong in doing Mathematics.*

For my study participant, a teacher-led mathematics classroom needs to be replaced with the students-led learning activities to ensure learners-friendly mathematics pedagogy. In a teacher-led mathematics classroom, as to my study participant, few mathematical problems given in the textbooks are solved by the teacher in the classroom and the students are asked to follow their teachers in solving the rest of the problems. In such a classroom, the teacher ensures whether the students understand the ways to solve the problems based on their responses (Morano et al., 2021). In such a way of leading a mathematics classroom, teachers are active in delivering the mathematics lessons and the role of students is as the receiver of their teachers' message. Mathematics pedagogy in such a classroom follows the *giver-receiver* continuum. According to my study participant, such pedagogy cannot be learners-friendly as it does not encourage the learners to be active, creative and innovative while cultivating first-hand experiences in Mathematics. He emphasized that such pedagogy needs to be replaced with some kind of alternative pedagogy in which the students are essentially provided with the opportunities to be creative, explorative and/or innovative in identifying, recognizing and/or uncovering new mathematical pattern, relationship, order, and sequence in relation to their own immediate lifeworld. One way to maintain such pedagogy in the mathematics classroom, for my study participant, is to provide the students with the opportunity of accomplishing a project work focusing the Mathematics lessons. In this method of learning Mathematics, the students learn themselves the meaning of being Mathematics learners by engaging themselves in given tasks in their real-life



situation. Teacher 2 emphasized on using a rubric-method to make mathematics pedagogy learners' friendly. I would like to present his words, in this connection, below:

*I am trying to introduce the rubric concept in teaching Mathematics. By this method, the students can find out their level of learning by themselves. Students feel difficulty in Mathematics. They often feel bored with it. In this condition, I want to develop such a concept that they can find out their level of learning in Mathematics by themselves. This method can vividly inform the students about their current achievement in Mathematics and what learning level they are supposed to obtain. For example, 1, 2, 3, 4, that is, if there are four different learning achievements, what point (1, 2, 3 and 4) they obtain. In this way, the level of learning they can know. It may also promote their curiosity towards learning. That is why I want to adopt this method of teaching Mathematics. I would also like to emphasize demonstrations and project works to be introduced as a part of learners-friendly pedagogy. There is a significant difference between the teaching method that I used now and then. I used teacher-centered teaching method in the past but now I use learner-centered teaching method in my mathematics classroom.*

*Well, if the way of teaching Mathematics is changed, it influences students' learning. We need to be up-to-date according to time.*

The concept of using rubrics in teaching-learning Mathematics in the classroom also emerged as one of the prominent ways of making mathematics pedagogy learners-friendly. This is the method that helps the students to identify the level of learning and/or understanding Mathematics by themselves. In the traditional way of assessment, the students are tagged with either *pass* or *fail* depending upon the marks they obtain in the examination. This way of assessment does not necessarily

encourage the learners to be critical and innovative on the way to learning Mathematics. For my study participant, learners-friendly mathematics pedagogy must help learners to assess themselves in terms of the questions: Who are they in learning Mathematics? Are they active or passive learners? Are they going to innovate and cultivate new experiences in Mathematics through the given context of learning Mathematics? How are they so in Mathematics? These questions essentially help the learners interpret themselves as mathematics learners in the given context. The concept of using rubrics seems relevant to help students interpret themselves as mathematics learners. Integrating such a method in mathematics pedagogy help them identify their level of learning Mathematics by themselves and learn the meaning of being Mathematics learners in the classroom. Teacher 1 emphasized on creating room for self-study on the part of learners while making mathematics pedagogy learners-friendly. In this regard, he told me:

*To make the mathematics pedagogy learners-friendly I feel that I must be studious, that is, I perform continuous learning on the part of myself. I must go through Mathematics books published from different publications. I must go through the reference materials available on the internet. In this way, I can get new ideas on how to adopt a new method and pedagogy while teaching Mathematics in the classroom. If we do not promote our self-study, we cannot maintain uniqueness in teaching Mathematics. Although we are competent in our subject are, this does not keep any meaning if it does not cause changes among the target students. Learners-friendly pedagogy can thus also be explained as the way of imparting knowledge and skills to the students.*

For my study participant, learners-friendly mathematics pedagogy must make space for self-study, continuous learning, and independent way of cultivating

knowledge on the part of the learners. Learning in such pedagogy is the product of intrinsic motivation on the part of the learners in which they get inspiration by themselves to read and consult extra learning resources in Mathematics. Pedagogy must be dynamic in nature. That is, it needs to go on changing as per the needs, interests, and the context of the learners. For this, different ways of learning depending upon the context can be employed or new ways of knowing mathematics can be acquired through learning and relearning from the textbooks and references continuously. It is an independent study on the part of the learners that helps them make their learning more vigorous and effective by creating lifelike images in the field of mathematics. But the question in this context is: how can the learners reveal their skill of self-study in Mathematics as a part of learners-friendly mathematics pedagogy? In this regard, Teacher 4 said:

*For this, we need to do group division, group work, presentation related to Mathematics lessons. In my opinion, let the student present the lesson and/or topic in the classroom and also let him/her discuss and present Mathematics lessons in the group. Sometimes ask the students one-by-one to come in front of the class and demonstrate their talent.*

What the learners cultivate through self-study can be demonstrated by various ways. For my study participant, especially in a learners-friendly pedagogy, group works, individual works, group discussions, and presentations are examples. While doing so, the students feel themselves the meaning of being learners in the mathematics classroom. By means of group discussions and presentations, the learner's demonstrate their skills of sharing and knowing the given lesson in Mathematics in the given environment. In this regard, Teacher 3 said:

*Some students might know the solution before it is discussed in the classroom. In this condition, I ask such students not to say the answer in advance so that those who are novice learners can get an opportunity to think creatively. If the answers are demonstrated in advance, the target students would not like to think deeply on its solution. I stop the intelligent students and then in the end I ask them to share their solutions to all in the classroom. Sometimes I ask them to write mathematical formula. For example, after teaching three consecutive chapters, I provide them a test to write all those formulas given in the chapters. Sometimes I provide them oral and sometimes written test. Some students can write but feel shy to speak, and some other students feel difficulty in writing but feel easy to speak. So, the written and oral test become useful for all. Sometimes I ask some students to come on the whiteboard to write the formula. I use different methods and techniques depending upon the diversities of the students in the classroom.*

*There are many obstacles in the making mathematics pedagogy learners-friendly. In the context of my school, the number of children is increasing day-by-day. There are 40-50 students in one classroom. The large number of students in one classroom creates difficulty in making the mathematics pedagogy learners-friendly. The sitting arrangement of the classroom is another disadvantage to create obstacles in making the mathematics pedagogy learners- friendly. If there were only 20-30 students in one classroom, the teaching-learning activities can be performed effectively. In the context of a small size for students in the classroom, desks and benches can be arranged in a U-shape and a V-shape. A small size of the students also provides the opportunity to make the space in the classroom which can provide them opportunity to perform learning activities. The other important thing is the timeframe. Mathematics pedagogy cannot be learners-friendly if only the 40-45*

*minutes are allocated for one period to teach Mathematics. The mathematics teacher may use experimentation, demonstration, group activity, and experiential learning. By experimentation, I mean that the teachers prove some mathematical relationship between two or more entities through an experiment. For me, demonstration is an activity in which students reveal their understanding and/or performance related to the given lesson in Mathematics. In experiential learning, the students acquire the first-hand experience of doing Mathematics. For all these, the teacher needs at least one hour. Some learning materials are to be bought. Some learning materials are to be constructed and collected. Some learning materials may be available in the schools.*

A learners-friendly pedagogy also encompasses the ways of imparting knowledge to the learners. A learners-friendly pedagogy, for Teacher 3, is the method, technique, and approach that the teachers use in the classroom in which the learners feel free to participate in the learning process. According to my participant Teacher 3, the pedagogy cannot be claimed to be learners-friendly in which the learners remain inactive. Giving an example of such pedagogy, he said that he, in the past, went to the classroom and solved few mathematical problems on the whiteboard. Based on that, he asked the students to solve other similar problems given in the mathematics textbook. Such way of imparting mathematics knowledge and skills in the classroom is supposed to be outdated and irrelevant to the learners' context. According to the teacher-participant, making the mathematics pedagogy learners-friendly needs to ensure learners' intense participation and engagement in the learning process. It is not the teacher, in learners-friendly mathematics pedagogy, but the learners themselves who decide what is wrong and what is right in solving mathematical problems.

It is not only my study participants but a number of scholars too who assert an active involvement of the learners in the learning process. For example, Simona (2013) claims that in a students' centered method of teaching students are provided with the opportunities to perform their own learning tasks in the classroom. Students' self-engagement in the learning process provides them opportunities to realize and connect oneself with the concept of mathematics and, thereby, feel themselves the meaning of learning Mathematics in the world in which they live by the mathematical relationship with similar others. I, in this context, would like to ask about the way through which the students' can be made active in the learning process.

For my study participants, rubrics, project works, and demonstrations can be made the part of mathematics pedagogy to make it learners-friendly. Incorporating such techniques in mathematics pedagogy, for him, helped the learners to rate the level of learning by themselves. By knowing their level of learning in Mathematics they can make a self-help plan to promote their achievement in Mathematics in the days ahead. As mentioned in the narrative, my study participant also asserted project works to be a technique to be included in the mathematics pedagogy to make it learners- friendly. But I would like to question, in this context, what features of a project work as a part of pedagogy contributes to make the mathematics pedagogy learners- friendly. In this regard, I would like to borrow the idea from Ma et al. (2019), who maintains that a project work provides opportunities to the learners to maximize their autonomy, freedom of choices to perform activities as per their needs and interests. While accomplishing the project work, the learners unfold their capabilities in his own pace. A project work in this context refers to the assignment in Mathematics in which the learners work either individually and/or in group to solve the problems. Demonstration, on the other hand, can also be taken as a technique to

make mathematics pedagogy learners-friendly as it provides them opportunities to connect their own ways of performing works with those of similar others in the classroom. All these techniques, namely rubrics, project work, and demonstration demand an active participation of the learners in which they learn about themselves in relation to Mathematics in the classroom.

With reference to the narrative mentioned above, use of ICT is another way of making mathematics pedagogy learners-friendly. Either one way or another, the learners are connected with ICT in their daily life situation. For Gerick and Koop (2016), the use of ICT simplifies the complex learning phenomenon to speed up the pace of learning on the part of the learners in question. Since ICTs such as cell phones, laptops, etc. are the part of the learners' life, their appropriate use in learning Mathematics is essential. For Andriyani et al. (2019), ICT provides the learners opportunities of online and offline learning. The Google and the YouTube, for example, are the sources available in the Internet through which the learners can get to a multiple solutions, techniques, and methods of solving their mathematical problems. After downloading the learning items from the internet, learners can save them in their cell phone and/or laptop to go through them in their free time. Use of animations, graphs, charts and real-like objects in the online mode of learning often contribute to make the pedagogy fun and fascinating. In this way, use of ICT accelerates the learning on the part of the learners. Since the students are most used to ICT, it is imperative for mathematics teachers in particular to get acquainted with the use of ICT in the teaching and learning of Mathematics in the classroom. The Mathematics teachers, as asserted in the narrative, need to be studious. That is, they must not limit to only the mathematics textbooks prescribed for the learners but some other reference materials to up-to-date their length and breadth of knowledge in

Mathematics. On the way to making mathematics pedagogy learners-friendly, the teachers in question need to consult a number of learning re/sources to inform themselves how a particular mathematical problem is solved by a number of scholars. Such information helps them compare their learners in the Mathematics classrooms with each others. The teachers also need to divide the learners in various groups and let them work in groups to make the meaning of the learning units. Group work and individual work designed by the teachers, on the way to making Mathematics pedagogy learners-friendly, also provide the learners opportunities to compare and contrast among themselves in terms their ability to solve Mathematics problems. According to the narrative, the mathematics teachers in the classroom need to ensure whether the learners accomplished their mathematics assignments by themselves. For the study participant, most of the learners in Mathematics intend to take help from others at home solving the problems given as the part of mathematics assignments. If they do so, they are not supposed to have learnt about solving the given Mathematics problems in the classroom and that the pedagogy in the classroom, in such situation, cannot be said to be learners-friendly. For my study participant, the mathematics pedagogy can be claimed to be learners-friendly only when it helps the learners in bringing about a desirable change in the mathematical behaviours in their daily life situation.

Learners-friendly mathematics pedagogy enables the students solve not only the mathematical problems listed out in the prescribed mathematics books but also the similar other mathematics problems given in the reference materials (Morano et al., 2021). Teachers in the mathematics classroom can use those materials and/or the environments which are available in the mathematics classroom. For example, measurement can be taught by asking the students measure the classroom doors and



windows, and so will be the case of teaching perimeter. This shows that teachers can use the objects available in the immediate environment of the learners to make mathematics pedagogy learners- friendly.

The role of teachers in making mathematics pedagogy appears to be multiple. When teachers ask the students to solve a particular Mathematics problem using the particular technique, then their role appears to be as an instructor. When the teacher arranges learning resources, divides the students in groups to accomplish the given mathematical tasks, the role appears to be as an administrator and/or a manager. When the teacher solves a mathematical problem in the classroom to show the students how the similar other kinds of problem can be solved, then they appear to be a model.

Learners-friendly mathematics pedagogy also includes the techniques and/or methods that encourage the students to think innovatively and creatively. Innovative and creative thinking, as asserted by Dunlop et al. (2020), often strengthen learners' capacity to unfold their innate potentials. But for others (Solheim et al., 2018), creativity and innovation as a technique in the classroom strengthens learning behaviours on the part of the learners. Thinking innovatively and creatively does not only expand the level of knowledge and rationality on the part of the learners but also sharpens their intuitions to reach the new conclusion (Rad et al., 2021). Such a way of learning is supposed to be everlasting in the life of the learners. In this sense, innovation and creation on the part of the mathematics learners seem to be the way of making mathematics pedagogy learners-friendly. But the question, in this context, is: how a Mathematics teacher can ensure *innovativeness* and *creativity* on the part of learners in the classroom? With reference to my study participant, I would say that a teacher can make students innovative and creative by providing them autonomy to

solve the given problem. By the term innovative, in this context, I mean to explore new ideas, concept and/or approaches to solve mathematics problems (Lopes & Soares, 2018). A teacher provides them with a mathematical task in line with the illustrated example and the student then go on thinking and creating their own way of using and innovating techniques and methods of solving the problems. While doing so, no external interference is to take place that would necessarily interrupt the students' process of being creative and innovative. Strengthening his views, for example, my study participant explained that a student need not to provide a solution in advance and that they are to be provided with options to choose rationally.

The method of assessing students' achievement also needs to be learners-friendly. Since individuals are different by their age, interest, needs, and ability to understand, their ways and magnitude of learning are also different. A teacher, thus, needs to assess their learning achievements in Mathematics using multiple ways. For example, some students feel easy to express their learning experiences in writing while some others feel easy in expressing the same verbally. In this context, one approach for assessing students' achievements in Mathematics may not be helpful in making Mathematics pedagogy learners-friendly. The mathematics teachers can, thus, use different possible ways of assessments so that the learners can participate depending upon their interests, ability, and level of understanding. For my study participant, *role paly* can be a useful method for assessing student's learning achievements in Mathematics in which a target student can perform the task of the teacher in solving the given Mathematics problem in the classroom (Lopes & Soares, 2018).

The Mathematics teacher under this study expressed some difficulties on the way to making the mathematics pedagogy learners-friendly. First, according the

mathematics teacher, a large classroom itself becomes a challenge for a mathematics teacher to create a learners-friendly environment. In the context of the public schools under this study, 40-50 students sit in one classroom. The teacher, thus, feels difficulty in creating a space for the role play, experimentation, demonstration, and experiential learning.

For my study participant, the mathematics pedagogy can be learners-friendly only when the teacher in question prepares the lesson in advance. Preparation of a lesson refers to a number of activities to be performed by a teacher before s/he deliver it in the classroom (Obara & Bikai, 2019). A teacher, according to Morano et al. (2021), needs to find out the ways of motivating the students to make them ready to learn the target lesson. As expressed by my study participant, the ways of motivating students for learning one particular lesson may be different from those which are appropriate in the context of delivering another lesson. It is therefore teachers' responsibility to determine which ways of motivation would be useful and helpful in the context of delivering the given lesson. The pedagogy in question becomes learners-friendly when it ensures a larger and broader participation of the learners (Priess-groben & Hyde, 2017). The learners, on the other hand, can ensure their participation in learning the given lesson in Mathematics if it meets their needs, interests, ability, and level of understanding (Takeuchi, 2015). Second, the selection, collection, and construction of learning resources play the determining role in making the Mathematics pedagogy learners-friendly (Park & McLeod, 2018). In this context, a teacher needs to think in advance the nature of the lesson to be delivered and the types of learning resources to be used while delivering the lessons. The learning resources in this context become the means to imparting the lesson, their appropriacy to the lesson is a must (Widjaja et al., 2021). Third, the selection and organizations of

learning activities play central role in making a learners-friendly pedagogy (Lopes & Soares, 2018). It is this stage of pedagogy in which the learners' participation and performance can be observed. It is also vital in the sense that the target learners connect their needs, interests, and ability to learn with the new learning items and demonstrate their level of participation. These are some key preparations to be ensured on the part of the mathematics teachers in advance to give their ways of teaching a status of learners-friendly.

### **Associating Previous Experiences with the New Ones**

A child cultivates experiences out of their life circumstances. Since the circumstances in life differ from one child to another, their experiences also differ. However, everyone's experience appears to be a building block on the way to acquiring knowledge and skills. If the new learning goes in line with the previous experiences, the learning remains quick and fast. Highlighting the need and importance of previous experience in making Mathematics pedagogy learners' friendly, Teacher 2 said:

*A prior experience of students is important to learn for a new experience. For example, I have started to use flip classrooms but it is not a new concept in classroom pedagogy. I did not know about flip classrooms before. I learned about it while participating in the ICT online training during COVID-19 pandemic. We participated in a training in which I learned about flip classrooms. Actually, I was following some part of the flipped classroom before but it was unknown to me by name. In this technique, students are informed in advance about the lesson to be taught in the next class. The students then come with some information about the lesson. When the same lesson is taught in the classroom, the students feel easy to understand and/or learn. It is not good to start a new lesson without giving a little concept in advance. It takes*

*about half an hour to introduce the new lesson if it is completely unknown to the students. If the students read the new lesson a little in advance, it becomes easy for teachers to impart concepts to the students. So far the matter of Mathematics is concerned, every lesson is connected with the previous ones. The link of the present lesson may be established with the lesson taught on the previous day, last week, last month, and last year. If the students have got a good learning experience and higher level of education in the immediate past, it supports them in learning the lessons that have not been able to discuss in the classroom yet. If we talk about algebra and mensuration, they might be related. Geometry might also be related. If these interrelated things are not discussed in the previous classroom, then the lesson to be taught later cannot be understood well. Therefore, students need to have a basic level of knowledge related to the proposed lesson to be taught in the classroom. In the case of my Mathematics classroom, I introduce the content and formula in advance before the lesson is actually started. I also ask the students to see the examples given in the book. In fact, the examples given before the lesson are not to be ignored. These examples are for students. A lot of techniques in the exercise are borrowed from the given examples. If the students go through these examples, they can easily solve the problems given in the exercise. Intelligent students can learn by themselves based on the given examples.*

*There are a lot of components under the teaching strategies in a mathematics classroom. Let me focus on practical things rather than theoretical ones. We can take example of our curriculum. It provides us guidelines. There are mathematics books published from different publications. The books of some publications consist of a lot of exercises, which I feel more than necessary. But we need to follow the mathematics curriculum. Teachers' Guide is another material to be considered in mathematics*

*pedagogy. We need to follow Teachers' Guide also. Although it is a government school, we need to keep some additional books as reference.*

*Our curriculum has also changed recently. I have talked with the officials from Curriculum Development Centre. I emphasized on awarding practical marks in Mathematics. Provision for practical marks in Mathematics is good, in my opinion, for both teachers and students. Although Mathematics is entirely a practical course, students are not to be provided with paper-pencil test for three hours. How frequently the students visit the mathematics lab, how frequently the students produce project works in Mathematics, to what extent the students participate in Mathematics related activities daily, these are to be counted as practical in Mathematics and for that they are to be provided 25-50 marks.*

*A lesson plan is another important component of mathematics pedagogy. Previously, there used to be a smaller number of students in the classroom. So, we prepared lesson plan in a written form. Now, there is an increased number of students in the classroom. The workload of teachers has become higher. So, we have not been able to prepare lesson plans in a written form. But preparing a lesson plan is very important to make the teaching-learning activities effective in the classroom. What kind of project work can be provided to the students so as to make them active learners? This question is to be duly considered in the lesson plan.*

*Each student is different from the other in relation to their learning abilities. Some students may learn faster than others. So, they are to be categorized depending upon their speed of learning.*

*Sometimes teachers can use the discussion method; sometimes the question-answer method; sometimes they can use induction and sometimes deduction; sometimes the teacher can use demonstration and sometimes the 'learning-by-doing'*

*technique to deliver mathematics lessons in the classroom. The teacher must not be rigid on using a particular technique in the classroom. An instructional method can be used depending upon the classroom situation, students' ability to learn, nature of the chapter, etc. For example, mensuration can be taught by taking the students outside the classroom but the same technique cannot be applied while teaching algebra. The method, techniques, and approaches of teaching/learning differ depending upon the nature of the contents and the lesson to be learned. The method and techniques used to teach the students last year may not be fit for the students this year. This is because learning is influenced by the students' attitude, family background, socio-cultural background, etc. The method and technique of teaching differ depending upon the nature of the students. Methods and techniques of teaching go on changing.*

Role of prior experience is vital so far as the matter of learning is concerned. Importance of prior experience in the learning of new experiences has been asserted by many scholars. For example, Takeuchi (2015) says that a child acquires new experiences based on what s/he learned in the past. Similarly, Widjaja et al. (2021) say that prior experience or knowledge functions as the prerequisite to acquiring new knowledge. Prior experience or knowledge, thus, appears to be the basis for the target experience, skills or knowledge. Obara and Bikai (2019), on the other hand, regard that prior knowledge on the part of the learner paves the ways for acquiring the knowledge which s/he is supposed to learn. In this way, the importance of prior knowledge, as asserted by my study participant, seems to be relevant especially on the way to making mathematics pedagogy learners- friendly. But the question that I put forth in this connection is: what does the prior experience have to do on the way to making mathematics pedagogy learners- friendly? For Widjaja et al. (2021), the prior

experience softens the part of learning in which the learners make a journey of learning starting from the easy learning point to the complex one. That is, the teacher, in this connection, introduces those learning experiences which the students associate them with their existing knowledge. While doing so, the learners feel that the new learning items may not be irritating or beyond their capacity to acquire. Prior experience in this sense appears to be the existing capacity or ability or competence on the part of the learners. Stepping upon it the learners make a journey to learn those things which they aim at.

Based on the understanding of prior experience I, thus, feel that my study participants' approach of associating learners' existing experience with the new one is justifiable and that it can be asserted as one of the techniques to make mathematics pedagogy learners-friendly. As a part of associating the existing knowledge with the new one, the teacher-participant informed the students about the lesson in advance. In this approach the students go through the examples given before the new learning lesson starts and develop a new concept about the target lesson given in the mathematics textbooks. For the teacher-participant, a new lesson in the mathematics textbook is often connected with the previous one.

The linkage between the previous and the new learning items are established through examples, illustrations, and summarization of the lesson. My student participant in the narrative also asserted the importance of prior experience in learning new items by saying that learning of the past exerts a positive force on the part of the children while learning the new item. Prior-experience has been termed as the basic level of knowledge by my study participant, especially for the new item of learning. Aligning with my study participant, Eickelmann et al. (2017) say that the basic level of knowledge creates an environment for new contents to be learned. In the case of



Mathematics, as claimed by my study participants, introducing basic formula, demonstration of illustration, narrating the process of formula, etc. and associating them with the new lesson can also be the way for making Mathematics pedagogy learners-friendly. Each chapter of Mathematics is preceded by some related examples. If the students conceptualize those examples in advance, they develop a concept on how to solve the mathematical problems given in the chapter/lesson.

In fact, many students in the case of my study sites, as explained by the teacher participant, lack the required previous experience and, hence, they often appear to be confused in learning the target lesson in the mathematics classroom. Although the mathematics curriculum of the previous grade has been claimed to have a connection with the later grade, the target learners in general do not appear to have possessed the required experiences. As stated by the teacher participant, either the whole curriculum of Mathematics is not covered in the previous grade or the pedagogy adopted in the previous mathematics classroom may not remain effective enough to instill the target mathematical experiences among the learners. As a result, the prior knowledge appears to be weak, which plays an unhelpful role in acquiring new mathematics lessons in the secondary level classrooms.

Besides the prior knowledge, the reference materials can play a vital role in making mathematics pedagogy learners-friendly. For example, the Teachers' Guide becomes helpful for the teacher to learn the ways to make mathematics pedagogy learners-friendly. A teacher's guide instructs the teacher to adapt some necessary strategies in the Mathematics classroom that vitally appears to be helpful in imparting Mathematics lessons easily and effectively. The teacher participant also asserted that the Mathematics teacher needs to get access to more reference materials to learn how one particular mathematical problem can be solved in multiple ways. For example,

one mathematical problem is solved in different ways in different textbooks. If the mathematics teacher consults these reference materials, they may enable themselves to use different techniques and methods to solve one and the same mathematical problems. Depending upon the prior experience, one learner can feel it easy to solve the same mathematical problem in one or another way. The enriched knowledge, techniques, experiences, and ways out on the part of the teacher, thus, plays a vital role in making mathematics pedagogy learners- friendly.

CHAPTER V  
MAKING MATHEMATICS PEDAGOGY LEARNERS- FRIENDLY: STUDENTS'  
NARRATIVE

On the way to generating data or narratives for researching learners-friendly mathematics pedagogy, I selected some students studying in secondary level schools. I selected the students from the schools where I interviewed Mathematics teachers to construct their narratives. While selecting the students, I consulted the mathematics teachers to help me find out those students who can give and/or explain profoundly about how to make the mathematics pedagogy learners-friendly. In this connection, first I went to grade 9 and grade 10 separately. I began to talk about mathematics pedagogy in general. While discussing with them, some students participated a lot in the discussion. Then I asked them to join the FGD and interviews to discuss intensely about how to make mathematics pedagogy learners-friendly. The narrative constructed through the interviews with the students is presented below:

**On-the-Spot Support**

Student 1 was one participant in this study. She was studying in grade 9 in one of the secondary schools selected for this study. She had crossed 15 years of age. According to her, she was a regular student in the class and that she often brought more than 75 marks (out of 100) in the exam of Mathematics. Based on the interview, I would like to present her narrative below:

*I enjoy the mathematics class. I understand what my Mathematics teacher explains in the classroom. For me, Mathematics class become easy when my mathematics teacher makes us solve the given mathematical problems in the classroom, just in front of himself. Whenever I begin to solve a mathematical problem,*

*I happen to fall into some kind of confusion. If I get immediate support or let's say on-the-spot support, I go ahead solving the problem uninterrupted. If I do not get support at the time when I get confusion, I feel irritated and feel the procedure of solving the mathematical problem burdensome. Once the chain of solving the mathematical problem is broken down, my interest in doing maths gets reduced. If there is a big gap between the support I get from the teacher and the lesson that I suppose to learn, I feel something like 'let's not do maths now'. Also, very often I lost confidence in doing Mathematics at the time when I see that my Mathematics teacher teaches, for example, lesson 10 and I do not know many lessons, for example, four, five and six. In such condition, I feel that I am poor at Mathematics and that it is not the course within the reach of my competence and ability.*

For Student 1, the mathematics pedagogy can be made learners- friendly if learners are supported as/when the difficulty arises. According to Engelbrecht et al. (2020), Mathematics is different from other subjects due its nature. It is a kind of language to communicate as we do through English and Nepali. However, it is more than a language in which the logical relation and the systematic patterning between the components are maintained. Mathematics offers a space for logical reasoning (Ma et al., 2019). But for Priess-groben and Hyde (2017), Mathematics is the branch of knowledge that promotes abstraction focusing counting, calculation, measurement, shapes, and motions of the physical objects. I, at this point of writing my dissertation, think that to make the mathematics pedagogy students friendly, a mathematics teacher needs to ensure whether the target learners are capable enough to deal with counting, calculation, logical reasoning, and abstraction. I also think that the degree of abstraction and logical reasoning differ on the part of the learners depending upon their location, culture, level of understanding, their prior knowledge on Mathematics

and the grade in which they study at present. When my student-participant in the narrative says that he often appears to be confused while solving the mathematics problems without the help of the teacher, he seems to express the meaning that his existing level of understanding in Mathematics does not support him sufficiently to learn new experiences in Mathematics. As a result, he often feels the need of teacher's support in solving the given mathematical problems. It is thus obvious that making mathematics pedagogy learners-friendly requires the association between the previous and the target learning experiences on the part of the learners.

The other important aspect of learners-friendly mathematics pedagogy is a hands-on support provided by the teacher to the learners in question. As asserted in the narrative, in the absence of the hands-on support on the part of the learners, Mathematics becomes burdensome, i.e. mystery that often creates perplexity. It also often breaks the chain of learning if the students do not get a hands-on support. As a result, the interest of the students in learning Mathematics is reduced. This shows that learners-friendly mathematics pedagogy must also incorporate the hands-on support of the teachers and that both the teachers and the students must also ensure whether the pedagogy in question continuously strengthen the chain of learning.

A learners-friendly mathematics pedagogy, as asserted in the narrative, requires to maintain and strengthen the confidence of the learners. This also means that it is the quality of the pedagogy that encourages the learners to feel strength in themselves in doing Mathematics. But the question arises as to what the pedagogy in question needs to incorporate to ensure an increased confidence of the learners. For the student participant in the narrative, a learner often loses confidence while learning Mathematics if s/he does not know the previous lessons at the time his teacher teaches the new learning experiences. That is, each and every lesson in the given text books of

Mathematics are interrelated and that the knowledge of one chapter in Mathematics often contributes to gaining knowledge in the chapter that follows. In such a condition, if the learners do not know the previous chapter in Mathematics, s/he often does not understand the preceding lessons. The learners thus feel that they are poor and that their level of understanding does not align with the lesson to be learned. As a result, s/he feels incapable, incompetent, and insufficient for the Mathematics subject as a whole.

While viewing the narrative of my study participant with the lens of social constructivism, I realized that the theory of zone of proximal development fit the best in this context. When the student under this study opined that she needed to solve Mathematics problems in front of the classroom so that she could get support from teachers, as/where necessary, she, according to the zone of proximal development theory under social constructivism, needed scaffolding. That is, she needed the support from someone at the time of being confused about solving the mathematics problems. In the case of getting immediate support from someone who knew the solutions of the particular problems, the students feel encouragement in approaching some other mathematical problems to solve.

When I connect the above set of understanding with the events of mathematics learning of my own during my school age, I realized that when my mathematics teachers in tuition class came home and taught me one by one problems given in a particular Mathematics chapter, I felt blessed. On the way to solving those Mathematics problems, very often I appeared to be confused and hence I immediately asked him to support me in solving those problems. In the such context, I felt being protected mathematically, pedagogically and contextually. At the time of being confused in Mathematics, students in general appeared with the sense of being

trapped within a difficult situation and hence s/he feel the need of being supported to overcome that particular situation. In the context of this research, making mathematics pedagogy learners friendly requires a chain of support in learning Mathematics until the mathematics lesson becomes the part of cognition of the students.

### **Ensuring the Chain of Success**

A new learning item has a strong connection with the previous one. That is, what a student learned in the past would provide him/her a space to learn something new at the present time. In this sense, mathematics pedagogy can be learners' friendly if it responds the learners' past memories, experiences, etc. According to the principle of learning, a student needs to learn known thing first and then the unknown learning item. This learning principle also encourages bringing forth the previous learning experiences with the new one.

Relating the idea as such, Student 2 in an interview said:

*I like the ways my teacher teaches in the classroom. But it is sometimes unmatching with what is asked in the exam. In my opinion, ways of learning Mathematics in the classroom needs to resemble the assessment that we come across during the year. For example, there are three different exams: first term, second term and third term. Each term takes place in a gap of four months. Besides these, sometimes a class test and a monthly test is also conducted. In our evaluation system, there is nothing a special provision for the weak students. All the students are evaluated through only one way. Students are treated based on the result in the formative test. Many of us are weak at Mathematics. Actually, this subject becomes difficult from the beginning of the school level. In the primary level, it was somehow good but as the time passed, Mathematics became difficult. I failed in Mathematics in*

*grade 7; however, I was promoted. I could not pass Mathematics in the annual exam, but also, I was promoted. When I reached grade 9 it was rather difficult. I then asked my parents to manage an extra coaching class. A tuition teacher was requested to support me in Mathematics. By the time I reached grade 10, I became a bit better at Mathematics. Well, I think if the pedagogy as I felt in the tuition class is considered in the school classroom, I would not need any tuition class in Mathematics.*

Evaluation of students' achievement is claimed to be the part of pedagogy. For Jackson and Cho (2018), the purpose of evaluation is to identify areas in which the students improved their behavior and the areas in which they need further support to improve. Evaluation also reveals how the target students perceive the given learning item and whether the way teacher teaches in the classroom maintains the level of quality as instructed in the curriculum. In this sense, students' assessment and/or evaluation is the part of classroom pedagogy in which the achievement of the students in the classroom is fairly justified. But I have a question to put forth in this regard: how can a unimodular evaluation system be useful for diversities of the students? That is, individuals are different by their prior experience and the level of understanding. Each student in the classroom learns differently depending upon their own level of understanding although the teacher teaches the same thing to all in the same way. If the students learn differently, then they are to be assessed differently. Mathematics has been very difficult subject for most of the students under this study. The main reason for such condition of Mathematics among students is the evaluation system. As stated by the student-participant in the narrative, mostly students appear to be poor at Mathematics from their primary schools. In each annual exam, they score less in Mathematics. However, they are promoted to upper grades supposing that they would do better in Mathematics in the next grade. But it so happens that in none of the



grade they get through the Mathematics exam. As a result, most of the students remains poor at Mathematics and, in this way, they reach the secondary level. Until they reach the secondary level, i.e., grade 9 and 10, they never ever pass a maths exam. Thus, they feel Mathematics as unreachable and the most difficult subject for them. Some students, as stated in the narrative, own private tutors to get support in Mathematics as they think that the classroom pedagogy would not be sufficient to meet the need of the annual exam. Such students are often reported to have acquired improved status of achievement in Mathematics.

At this hour of writing my dissertation, I would like to put forth a question: Why is the pedagogy adopted in the private tuition class more helpful than the one in the classroom? Private tuition in Mathematics has been popular mostly in the context of my study sites. Tuition, as reported by the students during the focus group discussion, has got importance with many respects. First, pedagogy in the classroom is general but the pedagogy adopted in the tuition classes is particular in nature. For example, a teacher in a mathematics classroom often focusses the mathematics problems and their solutions, while the teacher in a tuition class often focus to deliver the mathematics lesson considering the student's level of understanding and their way of receiving the mathematics lesson in question. In the classroom, the pedagogy is not individualized as there are many students and individualized pedagogy among many learners appear to be difficult to handle. But in the tuition classes the teacher, through an individualized pedagogy, intensely considers the students' age, maturity of learning, interests, needs, and their prior experiences as well. As a result, even the poorest student through the individual care and support becomes better at Mathematics in tuition classes. In this context of my dissertation, I would like to put

forth a question: how can the individual care and support become possible in the Mathematics classroom of a secondary school, especially to make it learners-friendly?

Viewing the student narrative with the individual and social constructivism provides me different understanding on making Mathematics pedagogy learners' friendly. For constructivism, collaborative, cooperative, integrative techniques are used to help students construct knowledge. If it is so, the assessment techniques also need to be in line with the techniques under which learning activities are performed. Constructivists' ways of learning Mathematics emphasize on learning through self and others, where learners are required to be active and creative participants. The assessment techniques in Mathematics must go in line with the constructivists' ways of learning Mathematics. That is, the assessment techniques in Mathematics need to provide the learners opportunities to evaluate by themselves. It also creates the room for collaborative assessment where every student evaluates the other in the classroom by using their own understanding of the mathematics lesson. The mathematics teachers in such sorts of evaluation contribute to create environment in which the students remain active in self and collaborative assessment. Such way of evaluation techniques challenge the traditional way of conducting exam: First Term, Second Term and Third Term, where the students are encouraged to participate in formative test and they are tagged with 'pass' or 'fail' depending upon the marks they obtained in the exam.

The most hazardous practice under traditional mathematics pedagogy was to promote the students to upper grade, as asserted in the narrative, without ensuring their capability to handle that level of Mathematics. Once students are termed as incapable of handling Mathematics of a particular grade, they are to be provided with opportunities to upgrade their mathematical ability and skills. Without doing so, they

are promoted to upper grade. The failure in learning Mathematics becomes thus the trend in the life of those particular students. Making Mathematics pedagogy thus avoids such trend and practice, replacing it with the constructivists' notion of assessment in Mathematics.

### **Learners Friendly Teachers**

Presence and appearance of teachers in the classroom play a significant role in the learning process. How a teacher deals with a student? To what extent the teacher is responsive to their students' needs and demands? In what ways a teacher creates welcoming environment for students so that they can feel easy to approach their teachers? These are some important questions that play a significant role in ensuring welcoming relation between the teachers and the students. While interviewing the students, the focus was given to explore the contribution of personal characteristics of teachers in making learners' friendly mathematics pedagogy. In this regard, Student 3 said:

*Well, I like to do Mathematics homework. It's good to do homework regularly. But if I understand well in the classroom, I enjoy Mathematics homework a lot. If I do not understand what the Mathematics teacher taught in the classroom, I then feel Mathematics homework is very difficult. When I do not understand a particular Mathematics lesson in the classroom, I often consult my friends. In such cases, I generally do not like to ask the teacher. I feel uneasy to ask the teacher and I also feel a little bit scared talking with the teacher. I feel something like if I explain to the teacher about my inability to understand a Mathematics lesson, I feel odd and that my teacher would scold me. Although he does not do that, I feel so. I often enjoy asking the friends who know better than me. If my friends do not know, then I ask my teacher. The teacher explains the problems and their solutions twice and thrice until I*

*understand. There are many students like me in the classroom who do not often understand. In this case, the teacher makes a group of such students and then explains the Mathematics problem in the group. I always sit with a friend who is very good at maths.*

Understanding Mathematics is a special task for the student-participants of my research. Understanding Mathematics in the classroom is related to doing homework. The better the students understand Mathematics in the classroom, the better and effective homework they can do at home. Those who do not understand clearly in the classroom, homework becomes difficult for them. But the student in such a condition develops their own private strategy under which they often approach those who are better at Mathematics. They learn from one another in the classroom. Learning from one another in the classroom is taken under the technique of a peer support. The role of a peer has been highly recognized by the scholars in the field of classroom pedagogy. For example, Gregory et al. (2019) says that peer support accelerates learning. For Engelbrecht et al. (2020), peers explain the given problem and its solution at speed and to the degree in which their colleagues adapt easily. In this context, I feel the need of incorporating peer support in the strategy of making Mathematics pedagogy learners-friendly.

Another important aspect of learners-friendly pedagogy is the teacher-student relationship. A harassed relationship between the teacher and the students often inhibits learning (Ma et al., 2019); a friendly relationship between the two, on the other hand, promotes learning in the classroom (Takeuchi, 2015). With reference to the narrative, I would say that the students in the context of public schools of Nepal often hesitate to ask questions for which they need support to solve (Gregory et al., 2019). In the continuum of relationship, the teacher is often regarded as higher and

students are regarded as lower in rank (Gregory et al., 2019). As a result, there is a hierarchy between the teacher and the student. Such a hierarchy is cultural and political. It is cultural because the teacher is respected as the higher personality in the teacher-student tradition (Jackson & Cho, 2018). Similarly, it is a political relationship because the teacher possesses the power to dominate their students (Morano et al., 2021). Such a hierarchy often creates a gap and/or distance between the two. This gap often inhibits learning on the part of the students. If Mathematics pedagogy needs to be made learners-friendly, it is important to reduce (if it is not eliminated) the gap. In other words, learners-friendly mathematics pedagogy requires encouraging and welcoming relationships between the teacher and the students.

I would also like to discuss the narrative with the lens of constructivists pedagogy. In the context of this research, the traditional-cultural and political relationship between the students and the teachers appeared to be blocked in making Mathematics pedagogy learners friendly. Such blocked are to be challenged and replaced by establishing constructivists' notion of teacher-students relationship on the way to making Mathematics pedagogy learners friendly. According to Sergei et al. (2019), constructivists' notion of teacher-student relationship demands teachers' role to be a facilitator, where s/he can support the students construct mathematical knowledge by themselves and/or in groups. The constructivist mathematics teacher prioritizes students prior experience or knowledge of Mathematics, values group discussion and/or interaction and their personal reflection upon their learning activities. In such pedagogy, the learners understand their own learning activities, their performances and outcome as the result of their own active, creative or intensive engagement and participation and that their teachers only supported them in doing so. In such way of learning Mathematics, thus, the students remain in the centre and the teachers in the

periphery of the pedagogy. Analysing the teacher-student relationship in constructivist pedagogy, especially based on priority, the students exceeded their teachers and the teachers, on the other hand, function as scaffolding to the students' learning performance. According to Baral (2020), the constructivist teachers encourage the students to adapt the learning strategies, instructional techniques and learning items depending upon their need, interests, ability and the resources available in the classroom. According to Cheryan et al. (2014), a constructivist teacher reveal themselves as facilitators where they provide encouraging environment, design appropriate learning activities and create opportunities for students help them make the meaning of their experiences in relation to the world in which they live. On the whole, constructivist ways of establishing teacher-student relation would be another step for ensuring learners' friendly mathematics pedagogy.

### **Using Accessories in Mathematics Classroom**

While interviewing students to explore their perspective on making Mathematics pedagogy learners friendly, use of accessories was emphasized much. The term 'accessories', in this context, may be equated with 'learning materials'. Learning materials lubricate the students' learning. That is, it brings liveliness in the learning process and that it does not create any room for students to feel boredom. Learning materials also plays roles in bridging the previous and the current experiences on the part of the students. It helps teacher and student to create a real-life environment in the classroom. Viewing the idea as such I encouraged the students to speak whether learning materials for them are useful in their Mathematics classroom. In reply, Student 4 said:

*Our mathematics teacher comes with a marker in the classroom. When he teaches geometry, he brings geometrical figures and shapes. When he teaches*

*transformation, he brings graphs and chart paper. He brings learning materials related to the chapter. But some lessons in Mathematics do not require learning materials. Sometimes he gives project works in Mathematics. He also brings mathematical formula written on the chart paper. He solves all the difficult mathematical problems on the whiteboard. If a student feels difficulty personally, he goes to such students and solves their problems in their exercise book. In my case, I have liked Mathematics since childhood. I also like it because it has a greater impact upon my career in later life. I therefore focus on Mathematics a lot. My interest in Mathematics is much, so I participate in mathematics pedagogy with greater interest. Actually, it has got a lot of value. It is revealed in social relationships. It is useful in explaining pattern, shape, structure and cause-effect relationship. In my opinion, Mathematics becomes easy for me if its pedagogy incorporates these properties in life.*

Use of learning resources has a greater importance in imparting mathematical lessons to the students. Various scholars reveal the vitality of learning materials variously, especially while talking about the quality of classroom teaching. For Takeuchi (2015), learning materials contribute to making classroom teaching lively. But for Rad et al. (2021), learning materials appear to be a means for carrying the meaning of the learning items to the intended learners. Learning materials, thus, is the part of pedagogy which not only makes the classroom lively and interesting but also strengthens students' motivation to learn the given item. The student-participant in the narrative expressed that it is the learning materials brought by the Mathematics teacher in the classroom that inspire the students to participate in learning activities. In the case of learning Mathematics in the classroom, as claimed in the narrative, the teacher sometimes brings materials related to geometry which gives the image of what

the teacher is going to deliver in the classroom. In this sense, learning materials also function in formulating the images of the learning unit through which the students conceptualise what is to be learned and how it is to be learned. Learning materials carry both the meaning and matters contributing to make the Mathematics pedagogy learners-friendly.

Another important aspect of using learning materials in the classroom is relating them with the real-life context. For example, *measurement* is a unit of mathematical knowledge that is to be taught explaining its scope in life. At what point of time in life does the knowledge of measurement appear to be useful and how? A mathematics teacher also needs to deal with such questions while imparting the knowledge on measurement to the intended students. Such a way of teaching Mathematics gives the impression that the learners are not learning Mathematics but through Mathematics they are learning life by themselves. This may also give the impression that life has got a mathematical relationship and/or patterning with the outer world. Mathematics, thus, raises consciousness upon life and its regulation with the world around. In this way, mathematics pedagogy becomes learner friendly because they learn life through Mathematics.



## CHAPTER VI

### FINDING, DISCUSSION, CONCLUSION, AND IMPLICATION

Based on the narratives and their interpretation in the previous chapter, I developed some key themes as the findings of the study. The key themes developed out of analysis and interpretation of the narratives are: (a) classroom setting for learners-friendly mathematics pedagogy, (b) learners' motivation in the mathematics classroom, (c) learning activities in the mathematics classroom, (d) learning resources for enhancing learners' mathematic skills, (e) evaluation procedures in the mathematics classroom, and (f) student-teacher relationship.

#### **Classroom Setting for Learners-Friendly Mathematics pedagogy**

The classroom setting is recognized as the component of learners-friendly Mathematics pedagogy. It is often equated with classroom management (Ma et al., 2019). I, in the context of this study, explain the term *classroom setting* as the availability, placement, and use of physical objects maintained for promoting the quality of learning in the classroom. This also means that the physical setting of the classroom has a greater influence over the pedagogy designed and implemented for imparting mathematical knowledge and skills to the intended learners. For Priessgrogen and Hyde (2017), the environment for effective pedagogy is created in the classroom essentially by bringing a balance between the techniques and technology used by the teachers. By the term *technique*, I mean the methods used to impart the mathematical knowledge and skills. By the term *technology*, I mean the devices, tools, systems, and mechanisms that the teacher uses to impart the intended contents of Mathematics. In the context of my study, the classroom setting refers to the physical arrangement in the classroom such as the arrangement of devices, tools, learning

materials, sitting arrangement of the students, so on and so forth. When I sought the meaning of balance between the techniques and technology, I arrived at the meaning that the Mathematics teachers may use the term *technique* to refer to the method of learning such as peer teaching, group discussion, demonstration, etc. Similarly, the term *balance* in the context of Mathematics classroom under this study may refer to the resemblance of the mathematical contents, the methods to impart these contents, and the devices and/or tools to be used in the classroom.

A learners-friendly classroom, as discussed by Eickelmann et al. (2017), assert the availability, adaptability, affordability, and usability of all the relevant resources arranged in the classroom for the purpose of meeting the educational goal. If I see the learners-friendly classroom pedagogy with these perspectives, I come to know that classroom arrangement is the state of availability of all those accessories and/or the materials for learning utilities. In the context of this study, a Mathematics teacher ensures whether all the required materials to impart the given unit of learning are available in the classroom. But a mere availability of such materials is not necessarily sufficient to make the mathematics pedagogy learners- friendly; their adaptability on the part of students is also a must. That is, the tools, devices, techniques, strategies and/or mechanisms available and/or designed for the mathematics classroom need to be adaptable by the intended learners. If the students in question cannot adapt these accessories available in the mathematics classroom, they can hardly get success in acquiring the intended meaning of the mathematics lesson. With reference to Zacarian et al. (2020), I understand adaptability on the part of the students as their ability to own those accessories. For this, the learning accessories in the mathematics classroom need to be within the reach of the capacity of the learners. The other important aspect

of learners-friendly pedagogy as asserted by Das et al. (2019) is the affordability for those tools, devices, techniques, and system (if any) on the part of the learners.

Affordable pedagogy, in the context of this study, refers to the investment, if any, required on the part of the learners must not be too burdensome. That is, if a learner needs to manage one pedagogical accessory by themselves to make a similar learning environment either in the school classroom or at home, they must not feel themselves incapable and insignificant. In the continuum of learners-friendly mathematics pedagogy, affordability for the mathematical learning devices and/or accessories thus seems to be unavoidable. Usability is another component of the learners-friendly pedagogy. I, however, in this context of my research writing, question myself as to what comes under usability and who is involved in giving the term *usability* a meaning in the learners-friendly mathematics pedagogy. Borrowing the idea of Obara and Bikai (2019), I agree to take usability as an ability/context through which the achievements are used to benefit one's own life. In the context of this study, I would say that the achievements of mathematics learners in the classroom need to be inherited in their ability and/or they must identify the context in which their mathematics achievements are used duly.

While setting the classroom for learners-friendly mathematics pedagogy it is obvious that the components of the mathematics classroom need to be duly available, adaptable, affordable, and usable. The components in this context are physical in nature that comprise reference materials, textbooks, desk and benches, whiteboard, ICTs, learning resources and their appropriate placement, enough space to perform group works and peer works, so on and so forth. Besides these, learners-friendly classroom arrangement was also found to be the arrangements of learners themselves. In the context of this study, the classroom consisted of a variety of students who

differed depending upon their level of understanding and prior knowledge. In this context, one method/technique was not appropriate to all in the same classroom. For example, some students were excellent at Mathematics and some others were average; while some others were underachievers. In this context, to ensure the learners' friendly mathematics pedagogy, the arrangement of the learners is preferred based on their category of knowledge. That is, the excellent students, average ones, and the underachievers are grouped differently in the classroom and then appropriate approaches/techniques/methods are to be used depending upon the level of understanding and/or prior knowledge of the groups of students. The students' arrangement, thus, in the learners-friendly mathematics pedagogy appears to be a part of a classroom setting.

A twenty first century mathematics classroom needs to be equipped with ICTs where the responsibilities of IT managers and users are added to the mathematics teachers. The role of ICT in the classroom pedagogy has variously been recognized. For Eickelmann et al. (2017), ICT can carry rich contents and deliver to the intended learners effectively within the given time and space. Similarly, for Lopes and Soares (2018), ICT gives the images of lived experiences on the part of the learners through which they connect those experiences to their own life and feel the learning as a part of their life. This shows that the use of ICT in the mathematics pedagogy is imperative through which, along with learning Mathematics, the learners are learning life in itself.

So far I have discussed classroom setting as a component of learners' friendly mathematics pedagogy. While doing so, I brought evidences from literature to reveal how appropriately managed Mathematics classroom influence learning on the part of the students. Now I would like to discuss the needs and importance of classroom

setting in making learners' friendly Mathematics pedagogy, especially with the lens of cognitive and social constructivism theory. .

Cognitive constructivism hold the views that knowledge is constructed depending upon one's own subjective explanation of the experiences. In the construction of knowledge, learners processes their experiences, intuition, ability, etc. into their mind to make the meaning of the world in which they live. While connecting individual cognitive constructivism with the classroom setting, I realize that the classroom setting in the context of this research requires improvement in line with the learners' cognitive levels. To put it differently, the classroom setting requires to resemble the learners' cognitive capacity, where the learners feel easy to connect their cognitive capacity with the classroom environment. In this context, I would like to question: what includes classroom setting and how it can be resemble the cognitive capacity of the learners? Going back to the research context again, I feel that classroom setting includes physical arrangements, the techniques and technology (devices, tools, learning materials, sitting arrangement) that the teachers use in the mathematics classroom. With reference to the cognitive constructivism, such arrangements must go in line with students' capacity to learn. For example, while arranging the devices, the teacher needs to ensure whether the use of devices matches the students' needs, interests and ability in relation to mathematics lessons to be learned.

In line with individual cognitive constructivism I would like to say that availability of learning materials, their adaptability, affordability and usability on the part of children are well examined.

On the other hand, social constructivism maintain that learning can be cultivated in social situation and that knowledge can be construction through social

interaction. If so, the classroom setting needs to be developed in the way that it would pave the ways for social interaction. Each student in the classroom has unique experience and hence a number of students in the classroom together form a social group to interact depending upon their previous experiences related to lesson to be taught. Their interaction encourage them to come into a conclusion, which gives shared meaning. In this sense, both the individual and social constructivism provides a guideline to transform the mathematics classroom to ensure learners' friendly mathematics pedagogy.

### **Approaches to Learning in Learners-Friendly Mathematics Pedagogy**

There are many learning approaches that appear to be effective depending upon the needs of the learners, nature of the contents to be delivered, and the context of the classroom. For Zacarian et al. (2020), various skills are to be counted as a part of classroom pedagogy such as critical and creative thinking, communicating, innovating, socialising, managing self, so on and so forth. While implementing these, learners' autonomy is a must. The learners feel and implicate their autonomy in the learners-friendly Mathematics pedagogy (Widjaja et al., 2021). As per the theory of learners' autonomy, the mathematics teacher needs to enable the students to learn the given mathematical lessons by themselves (Gregory et al., 2019). In the learners' autonomy classroom, the students need to have access to the learning devices, which they use to achieve their intended educational goal. The role of the teacher is auxiliary, contextual, and time-bound. The students, on the other hand, develop critical thinking and problem-solving skills. Through these skills, they appear to innovate a new idea or opinion on a particular problem to solve it. So far as the matter of mathematics classroom is concerned, the teacher needs to create such a classroom learning environment that encourages the students to be communicative, innovative,

social, and self-managing (Das et al., 2019). The students equip themselves with these skills and they carry them to their life to help themselves to grow up as a complete social being.

With reference to the above piece of writing, a learners-friendly mathematics pedagogy focuses the learning with special care and considerations in which the learners consider their teachers as facilitator but not as their tutor. In a learners-friendly Mathematics pedagogy, the teacher encourages the students to learn independently and that the students, on the other hand, explore knowledge on their own without being dependent upon the teachers (Morano et al., 2021). The pedagogy appears to be friendly to the students if it rises self-awareness and self-regulation and is self-sufficient to their personal learning styles. The teachers, on the other hand, can make the necessary learning tools available in the classroom and the students use them to identify their own ways and pace of learning.

In the context of this study, a child-centred pedagogy was claimed to be the learners-friendly pedagogy. But in my opinion, the child-centered approach of learning in the classroom also consists of the similar system, method, techniques, and mechanism of learning which have been discussed in the above section. For example, self-managing, innovating, communicating, self-regulating, and being autonomous in the process of learning are the parts of the child-centred pedagogy (Zacarian et al., 2020). In such a pedagogy, the learners in question are kept in the centre of the pedagogy and the teachers, learning contents, resources, etc. are the peripheral components of the pedagogy. Similarly, the teacher-to-student learning is less celebrated than the peer-to-peer learning in the child-centred approach of learning (Widjaja et al., 2021). That is, on the way to making the mathematics pedagogy

learners-friendly, the mathematics teachers need to ensure a classroom environment that supports peer-to-peer learning.

With reference to the context of this study, the learners-friendly mathematics pedagogy, referring to a child-centred approach of learning, requires to adapt inductivity in which the teachers introduce a few examples in the beginning and then later the students are asked to draw conclusions (mathematical formula in this context). The role and importance of an inductive way of learning in the classroom is asserted by various scholars. For example, Lopes and Soares (2018) equates inductivity as the worm eye-view in which the learners go through each and every event, circumstance, and illustration to reach a broader conclusion. Such a way of learning makes the learners active and that the learning becomes permanent (Ma et al., 2019). When the teacher under this study says that s/he gives examples first and then draw guidelines to solve similar other problems based on that example, s/he appears to use an inductive way of imparting the mathematical knowledge and skills to the intended students. When I borrow the idea of Morano et al. (2021), an inductive approach makes journey from a particular instance to a general outline. In the case of making the mathematics pedagogy learners-friendly, the mathematics teacher under this study was found to have provided their students with the opportunities to solve smaller problems and identify the pattern of solving the given mathematical problems through various examples and exercises. Such a way of doing Mathematics in the classroom was asserted to be useful for the learners in the sense that the target learners are active and engaged and that they get ample opportunities to be critical, creative, and innovate in finding out the solutions of the given mathematical problems.



The purpose of the classroom pedagogy is not only to impart knowledge to the students but also to equip them with some basic skills such as the skills of critical thinking, decision making, communication, technical, professional and personal, and analytical skills (Karen, 2017). Pedagogy is commonly known as the science of teaching. A learners-friendly mathematics pedagogy, thus, may refer to the process of teaching in which the learners entertain learning without being challenged physically, emotionally, socially, and cognitively (Das et al., 2019). The physical challenges in the context of the mathematics pedagogy represent the physical punishment which the students are likely to get on the way to learning in the classroom. Punishing students in the classroom is a long tradition in the classroom pedagogy in Nepal (Acharya, 2020). However, its trend is being reduced day- by- day. Emotional challenges in most of the public schools in Nepal is the mental harassment of the students in the name of their poor achievement and undisciplined activities. Social challenges in the classroom may mean to the deteriorated relationship among the students studying in the same class and also between the teacher and the students (Zacarian et al., 2020). If the Mathematics pedagogy is made to be learners- friendly, such challenges (physical, emotional, and social) are to be avoided.

So far I have discussed various approaches and skills to be used by Mathematics teachers in the classroom to make mathematics pedagogy learners' friendly. While doing so, I brought evidences from different literature to reveal how the approaches and skills are to be used to ensure effective learning on the part of the students. Now I would like to discuss approaches and skills to be used in the Mathematics classroom with the lens of individual and social constructivism. For individual constructivism, knowledge is constructed through accommodation and assimilation of experiences. During accommodation the children reframe their mental

state to fit with the external world. They do so especially to make room of new experiences in their mental setting. Assimilation on the other hand refers to a process through which the children in question acquire the characteristics of others in the group. While linking this theoretical assertion with this finding, I realize that mathematics pedagogy can be learners' friendly if the Mathematics teachers creates such an environment in the classroom where the learners' can built up mathematical knowledge through the process of assimilation and accommodation. That is, the students in the new classroom setting design their mental state in such a way that they take in the new mathematical experiences or lessons and they connect and interact with the recent mathematical experiences based on the earlier one. While doing so, they see how their colleagues in the classroom make meaning of those mathematical lessons. They compare oneself with the other in internalizing the new lesson in Mathematics in the classroom. On the journey of making the new lessons as a part of their knowledge, they may avoid and/or reform their previous experiences as/when necessary.

Social constructivism, on the other hand, may play a significant role in making mathematics pedagogy learners' friendly. According to social constructivism, learning depends upon the zone of proximal development. In this theory, some learning items can be internalized by the students by themselves and they can learn some other items with the support of others. In the classroom setting, there are a number of students, each has unique experiences to learn the given items. But some items becomes difficult for one student and some other item becomes difficult for some others. In this case, each begins to help the other to learn about the area of difficulty depending upon their previous experiences. As a result, each learner in a classroom can learn the entire items of learning. The mathematics teachers in the respects needs to identify the

students in relation to the easy and/or difficult learning items. They then are allowed to interact together to help each other to learn the item that they do not know. In the end of interaction, each learn the entire lesson.

### **Motivation in Learners-Friendly Mathematics Pedagogy**

Motivation is the first and the most focused aspect of classroom pedagogy. If students in the mathematics classroom are motivated duly, they innovate new concepts and/or pattern although they may not succeed immediately (Priess-groben & Hyde, 2017). For Priess-groben and Hyde (2017), the motivated learners in the mathematics classroom are enthusiastic to implicate the mathematical knowledge and skills that they acquired in the classroom into a new environment. Engelbrecht et al. (2020) on the other hand, says that motivation makes learners determined to their task and they go on using multiple strategies to solve the given problems until they are satisfied by themselves. It is, thus, the motivation on the part of the learners that lead them to be active and engaged learners. In the case of mathematics pedagogy, the learners try to think and rethink over the solutions to reach an accurate conclusion. Such students are intrinsically ready to participate actively in the homework, classwork, and project work provided by the teachers as a part of classroom pedagogy.

In the case of this study, motivation was found to be one of the important components of the learners-friendly mathematics pedagogy. The degree of friendliness in the mathematics pedagogy can be measured through the level of motivation among learners to learn a particular Mathematics lesson in the classroom (Zacarian et al., 2020). The mathematics teachers in the classroom need to ensure that their students in the classroom are ready to learn and that they are fully satisfied and happy with the knowledge and skills that they have learned so far. Such a situation in

the classroom contributes to build up and strengthen trust between the teacher and the students. It also contributes to create the classroom situation inspiring and welcoming. Most of the students in the public schools of Nepal, as discussed by one of the teacher-participants, get frustrated with the mathematics course only because they are not fully prepared to learn Mathematics in the classroom. If Mathematics pedagogy is to be made learners-friendly, it needs to make enough space for their motivation. In this context of research writing, I would like to put forth a question: What strategies does a Mathematics teacher need to develop to ensure motivation on the part of their students? One simple idea on ensuring motivation is to account for the needs of learners as a part of pedagogy. With reference to motivation theory developed by Abraham Maslow (Ma et al., 2019), I would like to claim that motivation on the part of learners can be ensured by satisfying their various needs. Maslow's theory of motivation provides a guideline of motivation for learning. The hierarchy of needs suggests that once the bottom level of the need is met, the students then move to meet the next level of need. In each layer of the needs, after being satisfied, the students get ready to learn. But the satisfaction of needs on the part of the students can be possible only by the support outside. In the context of this study, learners-friendly Mathematics pedagogy needs to make provision for satisfying the students' needs which are primarily related to their acquisition of Mathematics knowledge and skills. According to (Eickelmann et al., 2017), when the learners' needs are ensured and are satisfied, they participate in learning process with their full interests and ability. The students cultivate learning effectively depending upon the degree of motivation they acquired through satisfying their needs.

So far, the matter of mathematics learning is concerned, I feel that the most immediate needs of the learners are to meet the mathematical challenges in their

immediate social, cultural, economic and pedagogic landscapes. That is, they need to resolve those mathematical issues that are likely to take place while performing social activities and also while giving their social relationship a meaning. They may realize the use of learning Mathematics through the shape and pattern of their daily interaction with others in their social surrounding, give-and-take relationships that they establish with the community members, feast and festivals as they celebrate to realize their cultural belongingness, the economic activities that they perform through their profession and also through their involvement in money and matters relationships in daily life.

### **Learners-Friendly Mathematics pedagogy: Learning Resources in the Context**

Use of learning resources was found to be one of the components of learner's friendly mathematics pedagogy. Learning materials promotes students' learning achievements. It is often taken as an aid to accelerate learning in the classroom.

In the context of my study sites, the teacher realized the multiple function of learning materials. First, it creates images of the lesson in the mathematics classroom. Looking at the learning materials, the students in the classroom develop an image of what is going to be taught by their teachers. Second, it arose the curiosity among students to know more about what the materials is about and why it is brought to the classroom. Third, the learning materials, as claimed by the teacher-participant of this study, lubricates the pedagogy as a whole and/or the mechanism of learning so as to make learning takes place without any frictions. That is, creating a new image of Mathematics especially through acquiring new experiences and/or knowledge is a complex task. Merely a long lecture delivered by the mathematics teacher may not be sufficient to impart the intended mathematics knowledge and/or skills. The materials presented in the classroom helps the teacher create the images of real-life situations to

show their students how the given mathematical knowledge and/or skills are used. In this sense, learning resources thus helps to create the context in life where the students use their mathematical skills to feel life in terms of Mathematics. Fourth, learning materials, in the context of mathematics classroom in my study sites, contribute to structuring lesson plans for Mathematics. That is, the entire delivery of the Mathematics lessons is dependent upon what kind of learning materials are used and how they are used in the classroom (Jackson & Cho, 2018). The effectiveness of the delivery of the lesson in the Mathematics classroom is dependent upon the quality of learning materials. Fifth, learning materials function as guidelines for performing learning activities including their quality and magnitude.

Observing the need and importance of learning materials in making learners-friendly Mathematics pedagogy, the teacher and the student participants in the study schools claimed the frequent use of learning materials. For them, the materials are aligned with the contents, the learners' interests, the pedagogy or techniques to be used in the classroom, the competence of the teachers, and their availability. Since the materials have a meaningful connection with the various aspects of the pedagogy, they are regarded as the crux and the devices to promote friendliness in the entire process of classroom pedagogy. Learning materials for my teacher participants may be different depending upon the type of instructions. For example, the learning materials used for peer work in the classroom may be different from those which are used in group activities and also in individual classwork. My study participants claimed that they used sometimes answer-question method, sometimes project work method, sometimes demonstration and sometimes students' led learning activities. In all these different types of learning activities, they asserted to use different kind of learning materials. The variety of learning materials add on the beauty of teaching and

that amuse the students individually and in group. This particular function of learning materials in the Mathematics pedagogy provides the pedagogy as a whole to be learners-friendly.

So far I have discussed the roles of motivation on the part of learners to make Mathematics pedagogy learners' friendly. While doing so, I brought evidences from the literature related to motivation and connected them with Mathematics pedagogy. Now I would like to discuss motivation in the context of learners' friendly mathematics pedagogy, especially with the lens of individual and social constructivism. According to the individual constructivism, every learner in the Mathematics classroom possesses prior experiences. Stepping upon their prior experiences in relation to Mathematics they learn the new mathematical experiences. This also means that it is their prior experiences that inspire to acquire the new experiences in Mathematics. In this case, if the mathematics pedagogy in the classroom incorporate the Mathematics contents in line with the prior experience of the learners, the pedagogy then appear to be learners' friendly. In same way, according to the zone of proximal development under the social constructivism, each student knows something by themselves and they can learn something other by the help of their teachers and peers. In this sense, the mathematics pedagogy requires to lead students in the continuum of self to other where each student interact with the others and perceive and acquire the mathematics lessons differently based on their prior experiences. Mathematics pedagogy in this sense can be learners' friendly if it makes room for learning by oneself and also by interacting with the others in the same mathematics classroom.

### **Assessment in Learners-Friendly Mathematics Pedagogy**

Evaluation of students' achievements was found to be one of the major components of the learners-friendly mathematics pedagogy. But it was reported that the ongoing evaluation system created terror among the large number of students. Evaluation of students' achievements was found to have taken place thrice annually in a written form. Based on the value in digit they obtained in the examination, they are rated either *pass* or *fail*. Although letter grading system is in effect, the students' grades are often interpreted in the *pass-fail* continuum. Classroom pedagogy necessarily includes evaluation of students' achievement (Lopes & Soares, 2018).

The purpose behind students' evaluation is many. First, evaluation makes the students and the teachers aware on the educational goals. Based on the evaluation report, both the teachers and the students determine to what extent the educational goal is achieved and what is left to achieve. Second, evaluation report guides the educational plan, policy, investment, programs and activities in the school system. Aligning with it, the whole process of pedagogy in general and the mathematics pedagogy in particular can be improved. Third, evaluation provides feedback to the students, teachers, policy makers, course designer and textbook writer (Das et al., 2019). It is both a continuous and periodic process. It is a continuous process because every day a student is evaluated, especially by classwork, homework, project work, peer teaching and group work. It is a periodic process, especially for the schools where first, second and third term exams are scheduled to evaluate what students learned in the end of each term within the academic sessions.

In the context of this study, the students are evaluated through paper and pencil tests in Mathematics. Three different term exams, each takes place in the period of four months' time in a year, are performed to test what the students learned



in the given time period. Since the exam results are interpreted in pass-fail continuum, students in the context of this study often scare of the exam. In an interview, a teacher told me that students work hard just to focus their examination. In this connection, Mathematics pedagogy is not students' friendly but it is exam friendly. Once the students get through the exam in Mathematics, s/he is categorised as a learned one in Mathematics.

An exam-oriented mathematics pedagogy can hardly be given the status of learners-friendly pedagogy since it does not prepare the students for their life but for the forthcoming exam. The pedagogy performed to help students get through the exam can hardly transfer learning of any kind permanently. That is, the purpose of pedagogy is to bring permanent change in the behaviour of the students (Jackson & Cho, 2018). It aims at changing a particular behaviour for the lifetime ensuring the maximum benefit of the learners (Widjaja et al., 2021). But the mathematics pedagogy which takes place in the classroom in the context of this study mostly focuses exam but not the life time change. As a result, the pedagogy does not bring desirable change in learners as estimated in the mathematics curriculum of Nepal.

Whether mathematics pedagogy is learners- friendly can be assessed through the examination system it consists of. For Obara and Bikai (2019), Mathematics pedagogy can be said to be learners-friendly when it motivates learners to participate in the teaching learning activities more intensely. Similarly, Gregory et al. (2019) says learners-friendly mathematics pedagogy often focus assessment techniques which is continuous in nature and that it intends to promotes not only their cognitive capacity but also their emotional regulation, social relationship and personal engagement, especially in relation to learning Mathematics. The Mathematics exams organized for the students in the schools under this study focuses to measure only cognitive strength

of the learners but not the other aspects which essentially to be counted to make life better.

I would like to discuss assessment techniques with reference to constructivism to reveal how the learners are to be assessed under particular mathematics pedagogy to make it learners friendly. According to individual cognitive constructivism, the learners in mathematics classroom are provided with the opportunity of self-assessment while social constructivism emphasizes upon both peer and collaborative assessment. Individual cognitive constructivism asserts that learners acquire knowledge through assimilation and accommodation process. It is thus the learners who can ensure which learning experiences they are fit into and which learning experiences they can acquire further depending upon their prior experiences. Self-assessment thus help them to know themselves depending upon the previous learning experiences and the new experiences they are supposed to acquire. Peer and collaborative assessment on the other hand help them know how they appear in the eyes of the others who are similar in interests, needs and characters. While interacting with the others in the same classroom, they learn new mathematics experiences. The peer and collaborative assessment thus help them learn whether they learn in group makes meaning among their similar others.

### **Students-Teacher Relationships in Learners-Friendly Mathematics Pedagogy**

The relationships between the students and the teachers in the classroom was perceived as an essential component of learners-friendly mathematics pedagogy. The study participants reported that students-teachers relationship has greater influence over the learning achievements and the social enhancement of the learners in question. For Morano et al. (2021), the students with congenial and conducive relationship with teachers are likely to attain better learning performance in the

comparison of those who often remain in unhelpful relationship. In this context, my question is what a welcoming relationship between teachers and students has to do in making Mathematics pedagogy learners- friendly. According to Takeuchi (2015), if students remain with teachers in welcoming relationship, they have ample opportunity to interact with them and, in such condition, the students are likely to get productive guidance from the teachers on the way to making meaning of the world in which both the teachers and the students live. In the conducive relationship between teachers and the students, both appreciate one another and that both complement one another on the way to finding out the required solutions. The positive relationship between teachers and students maintains and strengthen the trust and harmony between the two. This helps the pedagogy not only to be academic but also social.

In the context of my study, teachers-students relationship maintains a gap. Although the teachers claimed to be more friendly and welcoming for their students, the later on the other hand asserted that they often hesitated and feel odd to consult teachers time and again to get my mathematics problems solved. The teachers-students relationship is rather rigid, stereotype and hierarchical. On the one hand, the teachers claimed that they were trained and that they often appear to be lucrative to their students. But the students on the other hand claimed that their mind is often occupied with the fear that their teacher would scold them if they frequently come closure to the teacher with the problems given in the Mathematics lessons. Being under such impression, the students in the context of my study often intended to learn with their friends in the classroom who were supposed to be better at Mathematics.

At this point of writing my dissertation, I would like to discuss students- teachers relationships with the lens of constructivism. Under constructivism, I have accounted for both individual and social constructivism to make meaning of my

participants' opinions on making Mathematics pedagogy learners' friendly.

According to individual constructivism, the learners own cognitive ability plays vital role in acquiring new learning experiences. Social constructivism on the other hand emphasizes that learning is acquired in social context especially through social interaction and collaboration.

Viewing these two theoretical claims I realize that the learners are to be more active on the way to constructing knowledge. In the context of this research, the Mathematics teachers play supplementary roles especially in creating such environment where the learners make meaning of the new learning items depending upon their prior knowledge, especially through the process of accommodation and assimilation (individual cognitive constructivism). The mathematics teachers also can support the learners by creating various peers' groups in the classroom where the learners participate in group discussion and interaction to make meaning of the given learning items in Mathematics. The teacher-students role therefore reflects the relationship between manager and their co-workers. That is, the teachers manage the environment for individual and collaborative learning and the students participate in the learning activities very actively depending upon their ability and choices.

### **Conclusion**

Knowledge and skills in mathematics is inevitable for life. It is therefore taught and learned from the beginning of school life. Mathematics, however, is often taken as one of the hardest subjects by most of the learners in schools. Their achievements often appear to be less than expected compared to other subjects such as Science and English. It creates fear and often unhelpful images in the mind of the learners as most of the students in the annual examinations and/or SEE are categorized as under-achievers in Mathematics. Why is Mathematics supposed to be

essentially hard by a large number of students? Why do most of the students fall into the category of underachiever? There are many perspectives to deal with these questions. First, mathematics curriculum is often made responsible for bringing such unhelpful condition in Mathematics pedagogy. Second, students are claimed to be unfocused on mathematics lessons while it is being taught in the classroom. AS a result, teaching-learning activities in the Mathematics classroom do not adequately benefit the target learners. Despite being these challenges, there is a possibility for making mathematics pedagogy learners' friendly.

Students' learning achievements has close relationship with the course and its pedagogy. I suppose if mathematics pedagogy is made learners-friendly, the underlying problems among students in Mathematics can be addressed duly. This research thus comes up with the conclusion that learners-friendly Mathematics pedagogy has certain guidelines and procedure. Classroom setting has an essential role to play in making mathematics pedagogy learners' friendly.

Since pedagogy takes place in the classroom, conducive classroom environment for the learners encourages them to participate in them duly. The approaches of teaching and learning in the classroom also vitally influence Mathematics pedagogy. That is, the balance between the contents and learning contents together with its delivery invites learners' attention. The appropriate teaching-learning approaches in mathematics classroom appeal the prior experiences and thereby make room for their active participation in the learning activities. The intensive their participation is, the welcoming the pedagogy is said to be. While doing so, the age, interest and needs of the learners play vital role.

No pedagogy can be learners-friendly if there is the absence of motivation on the part of learners. Motivation provides the learners a kind of energy, interest,

enthusiasm and curiosity to participate intensely in the teaching-learning activities in the classroom. This adds on the beauty on the way to making Mathematics pedagogy learners-friendly. Learning resource on the other hand has got greater importance in the process of making learners-friendly mathematics pedagogy. It contributes to make delivery of the contents easy, effective and intelligible. It strengthens the students' motivation to learn Mathematics and it also creates lively learning environment in the classroom where the students feel themselves the meaning of being mathematics students. The congenial relationships between the students and teachers also stands as a step to make Mathematics pedagogy learners-friendly. The favourable relationship between the students and the teachers encourages both in advancing the teaching-learning activities to the desirable extent. Assessment system can play very vital role to give the mathematics pedagogy a status of learners-friendly, that is, the evaluation of the students is not to create terror, anxiety and stress among them but an inspiration, encouragement and a welcoming images upon the lessons that they learn in the classroom. Learners-friendly Mathematics pedagogy is not a separate entity but a combination of these components considering the appropriacy to the students' contexts, their age, interests and needs as a whole.

### **Implication**

Based on the finding, discussions and conclusion I would like to present some key implication of this study. The finding of the study can be implicated in multiple areas related to various scholars and stakeholders which are discussed below:

#### **Implication for the Students**

The finding of the study may awaken the students to learn what makes the Mathematics pedagogy friendly to them. It may appeal them to understand that learning is not merely solving the problem but to bringing permanent changes in their

behaviors which are congenial to their socio-cultural and professional context. They also understand and implicate the finding in the way that they can verify their interest, needs and age with the contents, learning materials, teaching-learning activities, motivation, and the mathematics classroom setting. They may realize that learning achievements in Mathematics is not the result of their in/ability to understand and solve mathematical problems but it is the holistic system that incorporates a number of components.

### **Implication for the Mathematics Teachers**

The secondary school Mathematics teachers can also implicate the finding of this study in various ways. First, they can differentiate their own perspectives from the students' perspectives of teaching-learning Mathematics in the classroom. They may also integrate their perspectives with the perspectives of the students to reveal what it means to make mathematics pedagogy learners-friendly. The teachers in question importantly need to think that mathematics pedagogy must not be taken just as delivering the mathematical lessons in the classroom but it is a holistic representation of the learners' life in relation to the scope of Mathematics. On the way to making mathematics pedagogy learners-friendly, the teachers may evaluate themselves in terms of using learning resources, techniques to be employed to deliver the Mathematics lessons, motivation of the target learners, congeniality of the classroom setting, system of assessment that they use to evaluate students' learning achievements and their relationships with the students.

### **Implication for the School Management**

The findings will duly serve the members of the school management to decide what kind of Mathematics pedagogy can be given the status of students' friendly pedagogy. While monitoring the classroom pedagogy performed by the mathematics

teachers, the school management consider the components that are to be focused to make students' friendly mathematics pedagogy. Besides these, they also can contribute to manage the classroom, the learning resources and some other accessories that are vital to make the classroom pedagogy friendly to the learners.



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## APPENDIX I

How do teachers and students narrate their experience for ways of making Mathematics pedagogy learners' friendly?

Themes	Questions	Informants	Means of verification
Classroom setting	How do you engage students in setting mathematics classroom to make it friendly to them?		
	What, in your opinion, needs to be considered to make mathematics classroom friendly to students?		
	In what way do you contribute to developing Mathematics classroom learners' friendly?		
	How do you ensure that students engage themselves in ensuring effective learning in mathematics classroom?		
	What are the components to be focused in the mathematics classroom to make mathematics pedagogy learners' friendly?		
	What can further be done to improve mathematics classroom so as to make it learners' friendly?		
Teaching learning activities	What learning activities in your opinion are to be performed in Mathematics classroom to make it learners' friendly?		
	How are these activities performed?		
	In what ways these activities, in your opinion, contribute to make mathematics pedagogy learners' friendly?		
	What roles do you (teachers/students/HT/SMC) play while performing the specified teaching-learning activities in Mathematics classroom?		
	How do you think your engagement and role performance contribute to make teaching-learning activities learners' friendly?		
	What can further be done, in your opinion, to improve teaching-learning activities so as to make them learners' friendly?		

Learners' prior experience and mathematics pedagogy	How do you ensure learners' prior experience in Mathematics fit for the new learning items?		
	In what way do you connect learners' prior experiences with the mathematics lessons to be taught?		
	What components are considered under pedagogy/ instructional strategies in the mathematics classroom?		
	How do pedagogy/instructional techniques can be improved in the mathematics classroom to make it learners' friendly?		
Motivation	What are the ways and techniques used to motivate students in mathematics classroom?		
	How is the motivation of diverse students in mathematics classroom ensured?		
	How is the appealing environment created in the Mathematics classroom? What is the role of teachers and students in it?		
Assignment	What type of assignments are provided to the students in mathematics classroom? a) Individual b) Group c) Peer's work d) Project work e) Written work f) Ppt presentation		
	Who decide the volume of assignment? Why?		
	In what ways is the assignment ensured to be sufficient?		
	How efficiently do the students performed the assignment?		
	What is done, in case, the students do not do the assignment in a proper way?		
	What is the procedure of correcting assignment?		
	What can be done to improve the system of assignment in Mathematics to make it learners' friendly?		
Evaluation	What are the techniques used to evaluate students' achievements in Mathematics?		
	What strategies are adapted to enhance the performance of underachiever in Mathematics?		
	How can the existing system of		

	students' evaluation in Mathematics be improved to make it learners' friendly?		
	What indicators are determined to ensure that the students' learning experiences in Mathematics contribute to meet the expected goal?		
	Does the system of evaluation consist of cognitive, affective, and behavioural aspects of students? How they are ensured?		
Learning materials	What learning materials are used in the mathematics classroom? (a) the learning materials constructed by teachers? (b) The learning materials constructed by students (c) Readymade learning materials (d) Print/electronic/realia		
	Does the teacher contextualize the mathematics lesson? How does such contextualization remain helpful?		
	Does the learning material used to teach one lesson differ from that of the other? In what context do the teachers use similar or different learning materials in the mathematics classroom?		
	In what ways is the quality of learning materials determined or ensured to be learners friendly?		
Home-school relationship	Why do you think home-school relationship is useful to make mathematics pedagogy learners' friendly?		
	Why is the culture of home and culture of school needed to be considered to make learners' friendly mathematics pedagogy? a) Ways of students' rearing and caring at home and the ways to deal with students in school b) Activities involved at home and in the schools		