MY PEDAGOGICAL SENSITISATION TOWARDS HOLISTIC MATHEMATICS EDUCATION: A PRACTITIONER'S INQUIRY

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DECLARATION

I hereby declare that this dissertation has not been submitted earlier for the candidature for any other degree.

____________________ January 19, 2018

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DEDICATION

This dissertation is solely dedicated to my late father *Dilli Man Shrestha*, who always stood up for my education, and because of whom I am here at this brighter phase of education.

Master of Philosophy in Mathematics Education dissertation of *Indra Mani Shrestha* was presented on January 19, 2018.

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I understand and agree that my dissertation will become a part of the permanent collection of the Kathmandu University Library. My signature below authorizes the release of my dissertation to any reader upon request for scholarly purposes.

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ABSTRACT

An abstract of the dissertation of *Indra Mani Shrestha* for the degree of *Master of Philosophy in Mathematics Education* presented on January 19, 2018 at School of Education, Kathmandu University.

Title: *My Pedagogical Sensitisation Towards Holistic Mathematics Education: A Practitioner's Inquiry*

Abstract Approved: ________________________________

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In this research study, I critically explored, re/examined, re/invented and reflected on my pedagogical practices using auto/ethnography as research methodology and writing narratives as a method of inquiry under multi-paradigmatic research design space. I employed three key research paradigms – interpretivism, criticalism, and postmodernism. Since the purpose of my research study was to improve my pedagogical practices and explore non/linear approaches of teaching and learning of mathematics so as to envision holistic mathematics education, I employed three key grand theories as referents – Living Educational Theory, Transformative Learning Theory and Knowledge Constitutive Interests so as to explore my lived and living experiences and contradictions throughout the research study.

At the time I started my journey of pedagogical practices professionally, I would think that teaching mathematics was all about transmitting universal mathematical knowledge and skills to students as passive recipients, thereby often giving emphasis on algorithmic problem solving methods. I would believe to follow the assumptions of behaviourism that by controlling rewards and punishments, I could

shape my students' behaviour. However, my ways of knowing (epistemology), ways of being/becoming (ontology), ways of valuing (axiology) and ways of sensing (aesthetics) gradually got transformed to critically view 'self' and 'others' and act accordingly in due course of pedagogical practices from my master's and MPhil study, and hence I became a teacher with transformative sensibility.

Being a teacher with transformative sensibility, I often realised that I was unable to do justice to the principles of transformative education as I came to know that "transformative learning involves using cognitive, emotional, social and (for some) spiritual 'tools' to reconceptualise and reshape the relationship between the outer (material) and inner (non-material) worlds" (Taylor, 2015, pp. 1080-1081). I also realised that I was still using the *reductionist ideology,* which gives more emphasis to linear methods of teaching and learning, and prevents mathematics education from being an emergent domain of inquiry, thereby reducing it to an unchangeable discipline via the image of *curriculum as subject matter* (Luitel, 2009). Moreover, my materialistic approach of teaching at that time disconnected students' mathematics learning from that of humanistic perspective of education, thereby giving rise to linearity in teaching and learning of mathematics in the classroom.

In this regard, this research study was oriented to an inquiry into the problems of linear teaching and learning of mathematics due to reductionism in Nepali mathematics education so as to seek possible ways of improving my pedagogical practices through non/linear approaches of teaching and learning, and envision holistic Nepali mathematics education that is inclusive, authentic and empowering.

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ABBRIVIATIONS

BSc	Bachelor of Science
CDC	Curriculum Development Center
ISc	intermediate of Science
KU	Kathmandu University
KUSOED	Kathmandu University School of Education
MEd	Masters in Education
MPhil	Masters in Philosophy
MSc	Master of Science
NCTM	National Council of Teachers of Mathematics
SEE	Secondary Education Examination
SLC	School Leaving Certificate
TU	Tribhuvan University

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CHAPTER I

DESCRYING ANECDOTES TO ORIENT MY RESEARCH AGENDA

My journey of research inquiry begins from here with the orientation of my research agenda in which I have presented my research problems, research purpose, research questions, significance of the research study and theoretical referents. In the next chapter II, I have presented my research methods and methodologies in which I have discussed about multi-paradigmatic research design space, research logics and genres, quality standards and ethical standards. The chapters III, IV and V have addressed my research questions 1, 2 and 3 respectively. Finally, in the chapter VI, I have articulated my learning and reflection based on my research study. Therefore, all the chapters are coherent to one another and speak themselves dialectically to address the research problems and research questions so as to attain the purpose of the research study under multi-paradigmatic research design space.

I have used present tenses while writing this research report, and past tenses while presenting the narratives of past experiences.

Therefore, this chapter begins with my pedagogical journey as background of my research agenda. I have presented how I oriented my research agenda followed by problem statement and purpose of the research study. Further, I have formulated the research questions followed by significance of the research study and theoretical referents concluding the chapter with chapter summary.

My Pedagogical Odyssey: An Underpinning

Past stories are collected and recorded as history. I have my own history – the storage of autobiography of my pedagogical practices. At present, I descry those hidden stories which are untold for many years till date. As a researcher-practitioner, I feel that it is worthwhile to visit my lived and living experiences and contradictions to give rise to my research agenda. In this regard, I steadily unearth my hidden and untold stories to orient my research agenda by mixing and grinding some pertinent anecdotes out of them.

Threshold of My Formal Pedagogical Journey

"*Brother, we have come to request you for tuition class.*" Two young girls from my village – I still remember the event but not the girls as it's now fuzzy what exactly they would look like – approached me when I was enjoying my beautiful holidays after appearing the School Leaving Certificate (SLC) examinations, so-called "Iron-Gate", could be on March 1987. Both of them from Grade IX wanted to take tuition classes of Mathematics, Science and English from me for their upcoming final examinations. Not much excited, I, however, acquiesced to their request and began my journey of teaching mathematics informally since then.

"*Namaste, Indra Sir!*" I was surprised as a young boy, a friend of mine, was standing in front of me greeting me with mild smile on his face while I was busy in my farm works. It could be any day of June 1989 when people across the nation were fighting with the His Majesty's Government of Nepal for the establishment of multi-party democracy, and most of the schools and colleges were enforced to shut down, while I was waiting for my Intermediate of Science (ISc) result. "*I have come to request you for coaching classes of Mathematics for Grade X.*" He said and continued, "*Sir, I have introduced you as a Great Mathematician, the second Mr. Mathematician to over hundred students from our village and nearby villages as well, and they are excited to take your coaching class …*" I gave him an astute smile and in a while, a green signal. Moreover, at that time, I was known as a student who was very good, more precisely popular, at Mathematics subject, while on those days, learning mathematics was a tough gulp for most of the students. His metaphor 'Mr. Mathematician' was given to me after the name of our tremendous mathematics teacher who was famous in the village for his excellent algorithmic skills of mathematics teaching and who helped me sharpen my mathematical knowledge and (algorithmic) learning skills.

Probably, these two episodes of my teaching mathematics were the thresholds of my formal pedagogical practices. More so, these two experiences – I realise now –motivated me and gave initial courage to cross the threshold that marks the beginning of my pedagogical journey, because since then,

my higher studies and informal pedagogical practices (tuition and coaching classes) went side by side until I completed the study of Bachelor of Science (BSc) in 1992. After completing my BSc, I came to Kathmandu valley for the study of Master of Science (MSc) in Mathematics and joined Tribhuvan University (TU) in 1993. However, I could not accomplish my MSc study because of an unforeseen event occurred in my family: one of my younger brothers was caught by bone cancer on his right wrist due to which I was defied economically and hence completely involved myself into the family matters, and the circumstances led me to earning for survival in Kathmandu. Since then, I started formally my journey of teaching mathematics in the private English boarding schools.

Since the time I started my (professional) teaching in 1993, I was completely devoid of academic study; I quitted my master's degree and just involved myself in earning for daily living. In Nepal, it's (still) like a culture for novice ones to start their teaching career from such a private English boarding school that pays its teachers very low salary or teachers' pay scale depends on how skillfully they bargain with the school – meaning that teachers having no any pedagogical degree or trainings may also get chance to become a teacher, but experienced teachers are preferred. In my case, I began my career of teaching when one of my village friends requested me to substitute him for three months as he would leave for his master's exam. Since then, I have been continuously teaching mathematics in Kathmandu valley though I changed many schools throughout my career in seeking schools which paid better.

In due course of teaching mathematics in Kathmandu valley, I gained many pleasant and unpleasant experiences. When I joined my master's study and conducted research inquiry (Shrestha, 2011), I began to realise that I had been using controlled pedagogy which disengaged my students in learning of mathematics, and by which I was transmitting mathematical knowledge and skills to my students by enforcing them to follow the 'practice method'. However, once I conducted my master's research project under transformative education research, I encountered with constructivist pedagogy which helped me transform my ways of knowing, thinking and acting, and hence I began to implement different constructivist approaches of teaching and learning of mathematics in the classroom. In so doing, however, I was often in dilemma because of the entry of various transformative pedagogies (e.g. constructivist pedagogy) into my well-established controlled pedagogy.

In this regard, let me portray two narratives that articulate how controlled pedagogy and transformative pedagogy were dichotomous for me and what disempowering forces acted upon me to resist my transformative pedagogy.

Controlled and Transformative Pedagogies: A Dichotomy

"IM Sir, we hope that this year our SLC result will be the best because of your entry in our school. Thanks for joining our school." It could be any day of 2014, the

first day in a new school at Kathmandu valley. The Managing Director shook his hand with me after I signed the contract and concluded the meeting.

While recalling the above experience, I feel that it is really challenging for teachers to teach mathematics for grade X students in the context of Nepal, especially when a teacher is starting his/her journey in a new school, because all the embedded forces arise during that very span of time at the centre point of engaging all students in school for learning (practicing) mathematics from 6 am to 6 pm, twelve hours a day. The quantification of students' evaluation in School Leaving Certificate (SLC) examinations is must for all the stakeholders (Principal, school management, parents and students). Orienting to these assumptions, as a teacher, at that time of serving the new school, I was also driven by these motives and had to get involved myself in students' vigorous participation in mathematical *algorithmic problem solving*. However, I often felt that I was at high risk of fulfilling my fundamental objective that a mathematics teacher was to foster a more positive attitude to the subject and to make learning mathematics a less daunting experience for my students.

In this regard, the hidden and/or seen disempowering forces (e. g. notions of mathematics pedagogy, curriculum and assessment, stakeholders, west-centric worldview, etc.) gave rise to the pedagogies guided by behaviourism objective to the system of '*reward and punishment*', and the pedagogies guided by positivism objective to '*universal knowledge*'. Though I would prefer my students enjoy learning mathematics and spend time for improving their mathematical skills, the guiding principles of behaviourism and positivism developed in me often enforced them towards a series of mathematical *algorithmic problem solving* so as to prepare themselves for the up-coming SLC examinations.

At this point, it gave rise, in me, to an in/visible assumption which would cause chaos in the classroom by creating a mental picture of how things 'ought to be done'. I then put pressure in/directly on my students to go for the viable assumption of *practice method* on the basis of what I instructed as prior knowledge. As a teacher with transformative sensibility, I had got an idea that I should value my students taking responsibility and accountability of their own learning of mathematics. However, everything went as opposing to '*knowledge construction*' guided by constructivist approach of learning and Habermas' practical and emancipatory interests. Henceforth, I was coerced to abandon the transformative (e.g. constructivist) approach of teaching and learning and forget my transformative teaching pedagogy that I gained in course of my master's and MPhil study at Kathmandu University School of Education (KUSOED).

In this scenario, time and again, I realised that I was unable to do justice to the ideology driven by transformative education. I was just at the state of feeding students a package of mathematical knowledge and skills to produce pre-determined products. I also realised that I was using the *reductionist ideology* which prevents mathematics education from being an emergent domain of inquiry, thereby reducing it to an unchangeable discipline via the image of *curriculum as subject matter* (Luitel, 2017). I knew that this reductionist ideology was also one of the disempowering forces that were preventing me from relating the material and non-material worlds. Moreover, my materialistic approach of teaching at that time disconnected my students' mathematics learning from the humanistic approach of education.

In the mean time, my ethics raised questions: Where are my driving forces which involve understanding students' culturally situated selves especially in relating their social and natural worlds? Where are my empowering forces which connect mathematical learning to our (my and students') cultural world? Henceforth, I came to realise that power and politics inside the school were such disempowering forces that often eroded a dichotomy between controlled pedagogy and transformative pedagogy.

In this regard, let me further portray a narrative on how disempowering forces acted upon me often resisted my transformative pedagogical practices.

Disempowering Forces into Action

When my critical perspective of teaching mathematics gradually unearthed the *reductionist* ideology prevailed in the curriculum prescribed by the curriculum development centre(CDC), Nepal, recently I reviewed Luitel (2003, 2009, 2017) and realised that a reductionist methodology embedded in Nepali mathematics education portrays the process of curriculum development as prescribing a list of subject matter and teaching methods, thereby encouraging private schools' owners to play their games of business in the name of socialization of school through education.

With this frame of reference, I hereby set a scene of grade IX students preparing for the final examination every year in my school so as to articulate how disempowering forces compel me for using controlled (i.e. disengaged) pedagogy to 'get things done' or finish the course without paying due attention to my students' perspectives. In this regard, I agree Luitel (2009) that:

> Reductionist methodology, which is widespread in the field of education, has played role in reducing mathematics to a homogeneous, pure and unchanging discipline. Such a reductionist view of mathematics discards an ecologic and general view of knowing as embodiment of mathematical knowledge in cultural practices, thereby promoting pedagogy of 'knowledge imparting'... (p. 173)

It could be the year of 2012. I was known as a great champion among the mathematics teachers in a renowned school at the heart of Kathmandu valley. With an eye of the reductionist ideology, I could peer into my controlled pedagogy with a sensitive view to absorb students' aspirations of learning mathematics in a way that I would instruct them but not in a way that they would wish, because my school had developed the curriculum of grade IX in which 40 % of Grade X chapters were included, and I had to complete the whole syllabus of Grade IX before second term examination while that 40 % of Grade X syllabus before final examination. The basic assumption behind it was to prepare Grade IX students for school leaving certificate (SLC) examinations which they would face in the following year. The motive behind that assumption was to finish the Grade X syllabus within six months before the SLC examination would commence so that all the students would have sufficient time for revising the whole course when they will be in Grade X.

Subscribing to this scenario, now I realise that at that time, the curriculum was reduced to a rigid, compact and infallible document, thereby creating a chaotic environment in the mathematics classroom and enforcing me to finish the course without paying due attention to my students' perspectives. Moreover, such practice had been prevailing in my school since the time when the reformed curriculum was introduced by the curriculum development centre (CDC) some years back, which had provision of asking questions only from Grade X syllabus. Since then, the school leaving certificate (SLC) result of my school had been continuously quantified in terms of higher percentage with the increasing number of distinction holders. Such practice of teaching in my school led me to excluding mathematical practices arising from students' life-worlds.

This is an example that depicts what disempowering forces were in action to enhance such practices that were intentionally implemented in my school so as to prepare students to achieve higher percentage or grade in the SLC (School Leaving Certificate) examination. Now I realise and raise some issues: Who were responsible for such practices, the private school owners or the curriculum development centre (CDC)? In my opinion, the CDC was responsible for such practices as it developed the 'culturally decontextualised curriculum' (Luitel, 2003, 2009; Shrestha, 2011; Pant, 2015) which provided a loop hole to the entire private (and public as well) schools to exercise the practice of quantifying students' evaluation. I still bear in mind that at that time, some of the parents visited the school to complain to the Principal against such practices of including Grade X syllabus in Grade IX, but their efforts went in vain. However, the most surprising thing was that all those parents would come back again after the SLC result to give vote of thanks to the school and teachers as well and recompense the school by bringing more students for new admission in the school after their wards scored higher percentage beyond their expectation.

I would like to label this period of time as a *transitional phase* of my teaching. It was a vulnerable state for me and my students as well, because I now feel that I was incapable of establishing meaningful mathematics learning environment in the classroom at that time. However, in addition to reductionist approach, instructivist approach of teaching was also highly prevailing during the transitional phase of my teaching, because my direct instruction helped my students understand the meaning of *algorithmic problem solving skills,* and I found most of my students capable of conceptualising those algorithmic skills after a series of practices.

That's why; I departed from my constructivist approach of teaching and geared up my pace so as to finish the course within the prescribed time, thereby subordinating and/or neglecting my students' perspectives of learning. Moreover, my controlled pedagogy transformed me into an authoritarian teacher as an *active mathematical knowledge transmitter,* and hence transformed my students into the practitioners as *passive mathematical knowledge receivers,* thereby carving paths for my students to achieve better marks in mathematics. At this stage, I had a doubt if my students were taking ownership of their own understanding of mathematical skills, methods and concepts. Whatsoever, I kept up my effort in grooming my students by enforcing them to follow a series of algorithmic problem solving skills despite I observed some students in a state of anxiety created by my *get-things-done* notion of controlled (disengaged) pedagogy.

Orienting to the above problems, I come to realise now that I still have to resist many un/seen disempowering forces (probably I need to resist throughout my life) so as to prepare my students taking ownership of mathematics which they learn. In this regard, now-a-days, I often motivate my students to give emphasis on their self-study in addition to classroom practices because as a mathematics teacher one of my fundamental objectives is to foster a more positive attitude of the subject and to make mathematics learning a less daunting experience for my students. More so, I prefer my students enjoying doing and learning mathematics and spending time in improving their mathematical skills as essential for their everyday life-worlds and their future enterprise. I am deeply concerned about and/or deeply exploited by such a unique *controlled pedagogy* that I have been implementing rigorously in my classroom teaching, and thus envisage its adverse effect on my students' mathematical learning ability.

While writing the above experiences, some issues come up in my mind: Can there be any alternative to the unique *controlled (disengaged) pedagogy*? Can I reduce the adverse effect of disempowering forces and how? How can I be an effective teacher? Can critically reflective pedagogy be helpful for meaningful learning of mathematics? Can I develop myself as a critically reflective teacher? In this regard, Larrivee (2000) asserts that "Developing as a critically reflective teacher encompasses both the capacity for critical inquiry and self-reflection" (p. 294). Thus, while developing as a critically reflective teacher, I follow a process of self-observation and self-reflection, meaning that I look at my classroom practice, think about what I do, how I do and why I do it, and then evaluate if it works. By collecting information about what goes on in my classrooms and then analyzing and evaluating this information, I identify and explore my own practices and underlying beliefs.

In this regard, an issue is again raised in my mind: How can I encompass the capacity for critical self-reflection and self-observation so as to enter the students' empire and inquire their learning very intimately if I become a critically reflective teacher? However, I also admit that developing as a critically reflective teacher doesn't mean that controlled pedagogy is outdated and should be neglected, because I can't deny its longstanding values by which I was grown up as a mathematics teacher. Therefore, my concern here is to seek the possible ways of reducing its adverse hegemony in my pedagogical practices and in my students' learning of mathematics in the classroom.

Subscribing to all of the above discussion, the issues and problems raised during my pedagogical journey led me to orient my research agenda. For this, let me present how I oriented my research agenda by portraying some more narratives based on my lived and living experiences and contradictions.

Orienting My Research Agenda

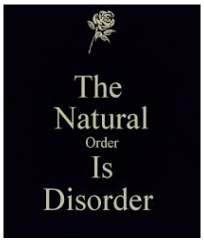
As mentioned above in this chapter while articulating my pedagogical journey, during more than two-decade long pedagogical voyage, I earned many pedagogical experiences and contradictions, which were coagulated as memories in my mind and piled up as journals in the files and folders of my Laptop. I have picked up a few of them as research problems and problematise them, giving rise to my research agenda, by articulating some life-like narratives in which I have portrayed myself as a teacher-researcher and as a research-participant, playing a dialectical role in the triangulation of teacher, researcher and research-participant.

Here, once again I have begun my research voyage as a story teller while problematising the main research issues of *controlled (disengaged) pedagogy* informed by culturally decontextualised mathematics curricula in the domain of mathematics education in Nepal, which depict my underlying assumptions about the *controlled (disengaged) pedagogy* being created due to reductionism in mathematics education. For example, teaching mathematics is all about disintegrating a problem into tiny knowledge and skills and establishing a certain relationship among the discrete parts with respect to the original problem by using certain directed teaching instructions, thereby resisting students from their engagement in a wide range of interactions in the classroom. While so doing, I have portrayed some narratives based on both cognitive domain and “affective domain (beliefs, values, attitudes, and emotions)” (Grootenboer & Marshman, 2016). Eventually, I have also articulated how the reductionist approach of my pedagogical practices gave birth to a breed of *pedagogical sensitisation* in me so as to envision a holistic mathematics education. The so-called problem statement is followed by the purpose of the research study and hence I articulated how research questions were emerged from the research problems.

Finally, I have discussed the significance of the research study and theoretical referents, and enclosed this chapter with chapter summary.

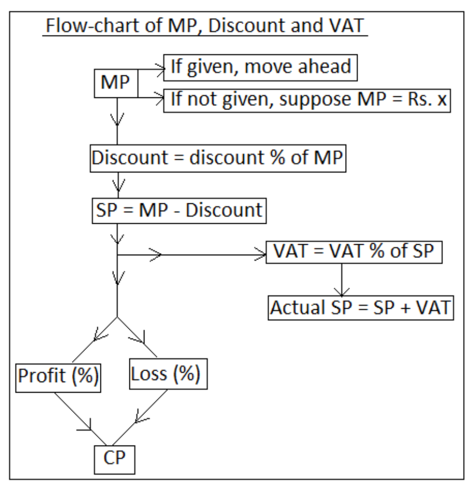
Problematising My Practice: Parturition of the Research Agenda

According to Vedic traditions, *rita* and *lila* are two opposing notions which



guide our everyday life – *rita* refers to the orderly aspects of everyday life while *lila* refers to chaos, mythos and playfulness of everyday life (Luitel, 2009; Shrestha, 2011).

Vedic traditions acknowledge that these two co-exists. As a mathematics teacher, I have experienced many *rita-like* and *lila-like* aspects of teaching and learning of mathematics during my long pedagogical voyage. Eventually, I click the button of my memory folders resting in my mind and recalled a classroom teaching-learning scenario of 2006 in which some students of Grade X approached me and shared their experiences with me, "*Sir, we usually enjoy doing mathematics till we get correct answers, but it gives us tension when we are unable to find correct answers.*" I replied, *"Yes, it's true, but always follow the flow-chart to find the correct answers easily, provided that you must have already memorized all the formulae."* The first girl of the class immediately replied to my comment, *"Yes Sir! It's true. I always follow your footsteps and methods, and hence I am able to find the correct answer. I feel easy solving problems when I am able to find patterns as you always suggest us in the*



*classroom."*This is one of my *rita-like* teaching and learning activities before I joined KUSOED for my master's study.

Moreover, I comprehend now that such a reductionist (*rita-like*) approach of my teaching of mathematics always un/helped my students develop my students' orderly algorithmic skills while learning mathematics in the classroom. In fact, as a reductionist mathematics teacher, I would often break a mathematical problem into several tiny components and *analyse* them to build up a sort of relationship among them so as to find out the intended learning outcome, while the unrelated parts of them were left over *unquestionably*. While articulating my research problems, I realised that my pedagogical problem was underneath those unquestionable parts which I usually would leave unaddressed during those days of teaching mathematics, instead of *interpreting* and linking them to students' everyday life-worlds, thereby neglecting/subordinating *lila-like* aspects of everyday life. Eventually, I came to realise that an ideology of reductionism mostly promotes *linear method* of teaching (e.g. *rita-like*), thereby neglecting/subordinating *nonlinear approach* of teaching (e.g. *lila-like*).

Subscribing to my master's research (Shrestha, 2011), albeit I could bring about some transformation in my consciousness level, or I would say, I became a mathematics teacher with transformative sensibilities, I felt that my effort of applying constructivist (transformative) approach of teaching for a meaningful learning of mathematics in the classroom was still in a state of "Yes/No" dualism (Luitel, 2009), thereby earnestly persuading me to apply mostly *controlled pedagogy* in the classroom. How did the controlled (disengaged) pedagogy persuade me to subordinate and/or neglect constructivist pedagogy under transformative pedagogy? In this regard, I often became thoughtful and began to think critically about the *being* aspect of teaching in the classroom, here the classroom I am urging is the environment of the whole classroom teaching and learning processes (e.g. Grundy, 1987), and the socio-cultural perspectives of the classroom "to indicate that explanations are formulated in terms of processes that occur in the classroom– individual interpretations and actions, and face-to-face interactions and discourse" (Cobb & Yackel, 1995, p. 5).

An issue is yet again raised in my mind: Was my classroom engaging during my *retrospective*[1]teaching of mathematics in schools? My meta/cognition adhered to this issue gave birth to my research problem when I compared my *introspective*[2] teaching of mathematics in schools and university with my *retrospective* teaching in schools. Then, what would be my possible *prospective*[3] pedagogy for my future professional career? In this regard, Mainzer (2009) stated that teaching is also an invention which happens when we stop thinking linearly and begin reinventing in a nonlinear complex reality. Therefore, for me a thousand-pound issue was that: Could I engage myself in the process of inventing and reinventing teaching and learning of mathematics? More so, would I be able to recognize and explain emergent behaviour as resulting from the dynamics of nonlinear interaction between the various components of my pedagogical practices?

When I began my university teaching for master's students in 2015 in the University of Valley, I began re/inventing my pedagogical practices by studying both *linear method* and *nonlinear approach* of teaching and learning of mathematics. In the process, I began to use the practice of engaging students in working on challenging, non-routine problems so as to help students develop a range of problem-

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[1] My retrospective teaching of mathematics covers my pedagogical practices before I joined my master's study in February 2007.
[2] My introspective teaching of mathematics refers to my pedagogical practices from the time when I started my master's study in February 2007 to till this research study was conducted.
[3] My retrospective phase of teaching of mathematics refers to my future pedagogical practices after accomplishing this research study.

solving strategies (i.e. heuristics), for example, ‘guess and check’ and ‘work backwards’. Therefore, as a heuristic teacher, I tried my best to apply the notion of “Theory into Practice” (Grundy, 1987). However, my schema (e.g. habits of mind) (Mezirow, 1997) subordinated this notion of “theory into practice”, thereby persuading me for more theoretical perspective of teaching and learning.

In this regard, I recall now one of the master’s students who gave his feedback on my pedagogical practices via mail, “*I have found you very laborious and well prepared while coming inside the classroom. You have strong content knowledge … Your ways of linking curriculum with day to day life activities and encouraging us to teach math contextually are very good … Your encouragement for us to read lots of paper and write the assignments reflectively has helped me a lot in professional writing …*” He further wrote, “*… Your presentation slides were too messy … Sometimes your ways of dealing with students can pass wrong impression on students. You might know about whom I am referring to … Our expectation was that we would be able to develop and design a model school mathematics curriculum but that did not happen …*” Here, the student gave my strong and weak points while I was teaching them the course “Curricula in Mathematics Education” in the University of Valley.

Let me further portray an anecdote about an incident occurred with a master’s *student*, and about which the (above) student was talking about in his feedback. It could be a day of April, 2015. Ah! I recall some of the bitter moments when I encountered with that *student* who had missed the first three classes and got into trouble. Despite giving feedback and talking personally several times in order to help him improve his ways of writing assignments (e.g. reflective journals), I found him doing his assignments using “copy-paste method”

from various internet sources, thereby enhancing the skill of "plagiarism" through his writing. Though I regularly interacted with him and encouraged him to submit his assignments within deadline, he could not do it on time, and hence, maybe, to meet the deadline, he followed such a nasty "short-cut method" of doing his assignments.

That day, I had a good conversation with him in the classroom about his act of plagiarism as well as his inactive participation in the classroom activities, and unfortunately, there were exchange of a few words between us (However, the words from my side might be tough but were not irrelevant in my opinion). Since then, I began to sense his annoyance towards me whenever I asked him for his active participation in the classroom activities. Nevertheless, I tried my best to regain his attitude and confidence after I shared this experience with my Professor (who was teaching me my ongoing MPhil courses). At this stage, such experience of teaching made me think and revisit my pedagogical practices and hence I comprehended why I was often being pulled by the gravity of my own affective domain. Thus, I realise now that I shouldn't have disclosed his weaknesses in front of all in the classroom! In this regard, I feel now that my habits of mind coagulated with my linear pedagogical practices often dominate the nonlinear approaches of my pedagogy that help associate the affective domains of both teacher and students during teaching and learning processes of mathematics in the classroom. More so, I hereby confess that I wish to engage myself in the act of re/inventing my own pedagogical practices, which is, moreover, my pedagogical sensitisation towards mathematics.

In the mean time, many emerging issues come into my mind: Am I strong enough to transform myself from a conventional teacher to a constructivist teacher? or let me admit myself, am I still in a process of transformation in terms of my pedagogical practices, especially peering into my ineffable affective domain? How would I improve and achieve the height of such transformation in me then? I understand that the theoretical aspect of affective domain has a great influence in improving my pedagogical practices. Nevertheless, I feel that I am still fighting with *egocentric-self* (probably will be fighting throughout life) so as to transform my "*self*" through my pedagogical practices. Why is this happening with me? Is transformation an ongoing process? "How do I improve what I am doing" (Whitehead, 2011)? I admit that my strong theoretical knowledge (based on students' feedback) is not good enough to transform my "self" so as to create conducive classroom environment for a meaningful learning of mathematics until and unless I transform my theoretical knowledge into practical action.

Although my focus was on how I re/invent my pedagogy that incorporates both linear and nonlinear approaches of teaching and learning of mathematics, I now realise that I was still accustomed by and large to the linear methods of teaching promoted by reductionist mathematics pedagogy, the gravity of which often pulls me down towards its mesmeric centre. That's why; I felt that despite having full authority of developing the master's course, I could not be able to include practical aspects in the course as demanded by the students: one of the several reasons behind it might be the schema of reductionism set in my mind for many years.

In that situation, many issues whirled in my mind: Did reductionist approach of my teaching induce students to look for mostly the *being* aspects of *the* mathematics by preventing them from *becoming* aspects? In the other words, did reductionism mostly persuade my students to seek for the intended answers of 'what' or did it disempower them so as not to look into 'how' and 'why' questions? In this regard, I am now fairly aware about a belief that such a reductionist approach of teaching is guided by the instrumental (objective) knowledge generated by Habermas' technical interest, thereby subordinating and/or neglecting the communicative (subjective) knowledge generated by practical interest and emancipatory (critical) knowledge generated by emancipatory interest (Habermas, 1972). If so, was I totally guided by the knowledge generated by Habermas' technical interest? In this regard, was it the fact that my disengaged pedagogical practices often induce me to find certain patterns of mathematical life-world with the aid of my cognition, thereby neglecting and/or subordinating my affective domain towards mathematics and its culturally embedded aspects? In the mean time, I realised and raised some more germane issues: What caused me to exercise mostly my "mind" during teaching mathematics in the classroom? Did I become a slave of cognition? Why did I treat mathematics as a mind game? Why is affective domain subordinated and/or neglected in mathematics teaching? Was it because of culturally decontextualised mathematics education? If so, then another reductionism arises here to view the whole mathematics education in Nepal. Based on these issues, I now feel that the mathematics education in Nepal has been reduced into *culturally decontextualised curriculum*, *disengaged pedagogy* and *standardized assessment system,* which promote cognitive domain but subordinate and/or neglect affective domain in teaching and learning of mathematics.

Above all, I believe that a teacher is the major actor whose *pedagogical commitment* plays an important role in teaching and learning of mathematics. As a long-experienced teacher, I realise now that I should gain some artistic teaching skills so that I would be able to incorporate both cognitive and affective domains with an aid of both linear and nonlinear approaches of teaching and learning of mathematics. How would I gain such artistic skills of teaching? How would I activate my affective domain in my pedagogical practices to get rid of controlled (disengaged) pedagogy?

In this regard, I feel that there was a big *pedagogical ecotone* between my cognitive and affective ecologies. If so, then would I really be able to resolve my *pedagogical ecotone* between the cognitive domain and affective domain? More so, I could also observe *learning ecotone* between cognitive and affective ecologies of my students. Then, how far would I be able to reduce the *learning ecotone* between cognitive and affective domains of my students?

In the midst of my problems regarding pedagogical practices, I find myself as an active researcher-practitioner who envisages possibilities of narrowing down both the *pedagogical ecotone* and *learning ecotone* between the cognitive and affective domains, and which are, unquestionably, due to the adverse result of hegemonic linear method of teaching. Moreover, I am not concerned simply with narrowing down the ecotone, I would prefer to be more inclusive regarding both cognitive and affective domains with an aid of both linear and nonlinear approaches of teaching and learning. Finally, I am able to emerge with pertinent issues: How and why did I give over-emphasis to cognitive domain in teaching and learning of Mathematics? In what ways did I subordinate and/or neglect affective domain, and how can I be inclusive of both cognitive and affective domain in teaching and learning of mathematics? What persuaded me to practice mostly linear pedagogy, and how can I be inclusive of both linear and nonlinear teaching approaches of teaching and learning of mathematics? What notions enhanced my pedagogical sensitisation towards Mathematics Education to envision my holistic way of living?

In this regard, I realise that my reductionist pedagogical approach mostly – persuades me to practice (only) disengaged pedagogy; induces me to reduce a problem into parts, *analyse* them to get intended outcome and left unrelated parts *unquestionably uninterpreted*; gives over-emphasis on cognitive domain and neglects or subordinates affective domain; has focus mostly on *rita-like* structures of practices; gives rise to linearity in my teaching practices and student's learning of mathematics, but subordinates and/or neglects nonlinear approaches of my teaching practices and student's learning of Mathematics; and has a great influence on my existing pedagogical practices.

Therefore, I am in a state of "Yes/No" dualism in favour of exclusively teacher centred linear method of teaching, thereby persuading me to practice *controlled (disengaged) pedagogy* and disempowering my students while learning mathematics. That's why; I am thoughtful about both the *being* aspect and *becoming* aspect of my pedagogical practices. How did such a consciousness raise in my "self"? It was because during my teaching in the University, I began re/inventing my pedagogical practices by studying both linearity and nonlinearity of teaching and learning of mathematics, which made me realise that my habits of mind coagulated with linear pedagogical approach often was dominating the nonlinear pedagogical approach which links both cognitive and affective domains of both teacher and students during teaching-learning process of mathematics in the classroom. Therefore, I wish to engage myself in the acts of re/inventing my own pedagogical practices in terms of both cognitive and affective domains, which is my pedagogical sensitisation towards mathematics.

At this stage, I find myself in a position where I am fighting with *egocentric-self* so as to transform my "*self*" through my pedagogical practices and realise that in between cognitive and affective domain, I have a *pedagogical ecotone* and so do students have *learning ecotone,* both of which I as a teacher-researcher wish to narrow down. Ultimately, my research study inquires my pedagogical sensitisation towards mathematics that helps me envision a holistic mathematics education.

Further, in due course of so-called problematising, let me portray a few narratives on how cognitive domain enhances linearity in teaching and learning of mathematics, and how the hegemony of linearity has been dominating nonlinear approach of teaching and learning of mathematics during my pedagogical practices.

Cognitive Domain: Linearity in Mathematics Pedagogy

How do people think? How do people read? How do people learn? How do people memorize facts? How do people forget? How do people know that they don't know something? These issues are related to "mind" – a major hard-disk of cognitive domain. In this regard, Brandimonte, Bruno and Collina, (2006) mentioned that cognition is not merely a process, but a mental process by which external or internal input is transformed, reduced, elaborated, stored, recovered, and used. According to the dictionary meaning, cognition is "action or process of acquiring knowledge, by reasoning or by intuition or through the senses" (Oxford Advanced Learner's Dictionary, 1990).

After reviewing various literatures, I came to internalize that traditionally cognition is central to mind and mental processes, thereby giving emphasis on human thinking which deals with propositional forms of knowledge. Two contemporaries Jean Piaget and Lev Vygotsky explored how cognition works in generating knowledge. Piaget explored that as children develop with their biological and general age, they progress through different cognitive stages characterized by unique ways of understanding the world. He identified four stages of cognitive development: sensorimotor (0-2 years), preoperational (2-7 years), concrete operational (7-11 years) and formal operational (above 11 years) (Ojose, 2008). While Vygotsky explored that the sociocultural environment is critical for cognitive development of children. He developed the concept of zone of proximal development (ZPD) which is a gap between what learners are able to do independently (actual level of development), and what they may need help in learning (potential level of development) (Blake, & Pope, 2008). Therefore, Piaget believes that learning is construction based on prior knowledge (e.g. constructivism), while Vygotsky believes that learning occurs through social interaction and instruction (e.g. social constructivism).

In this regard, based on my experiences, I realise that cognition is more inclined to acquiring knowledge through deductive reasoning in a linear way as a product of didactic pedagogy, thereby subordinating/neglecting the key role of intuition and sense in meaning making process while teaching and learning of mathematics. According to De Bock, et. al (2002), "linearity is, from a long way back, a key concept in mathematics and science education from elementary to university" (p. 311).In fact, I also feel that I have learned as well as taught mathematics based on mostly the notion of linearity though I have got some sense of nonlinearity while learning and teaching of mathematics throughout my educational journey. Further, I feel that such idea of linearity, from both psychological and mathematical point of view, comes first in teachers' and students' mind as an inherent attribute, thereby giving rise to linear way of thinking and acting so that both teachers and students are, after all, trapped by the 'illusion of linearity' (De Bock, et. al, 2002), which drives their teaching and learning of mathematics as if everything in mathematics goes in a linear and mechanistic way everywhere. Such illusion of linearity limits teachers' and students' thinking process within a boundary of rules of dos and don'ts, thereby killing students' creativity – a wide range of open thinking and acting in the classroom. Let me portray some narratives on the illusion of linearity based on my lived experiences and contradictions.

The Illusion of Linearity: A Puzzled Momentum

"If it takes 3 hours to dry 1 shirt in the sun, how long does it take to dry 2 shirts?" I still remember this famous funny question asked by my colleague teachers. Moreover, I would also use it in my maths class to make a fun while teaching the unitary method and my students are puzzled by such illusion.

I have come to realise now that the illusion of linearity – a kind of false consciousness that provokes people to move ahead with full confidence as if it is true like a thirsty deer runs across the desert in search of water targeting the mirage – sometimes misleads both teachers and students in course of teaching and learning of mathematics. Many times, I have encountered with such illusions and found students misusing linearity in many non-linear situations such as while solving the problem like "If 20 labourers can build a house in 60 days, how many labourers can build the same house in 1 day?" Can 1200 labourers build the house just in a day? So absurd! In such a case of proportionality, students blindly misuse linear method and get into trouble; they are fully unaware that proportionality just gives an approximate answer and helps them guess and estimate their everyday problems mathematically.

Some years back, while teaching volume of sphere in Grade X, I asked a question – *If a radius of a sphere is doubled, what would be the volume of the new sphere?* A student replied, in no time, that it would be doubled. Upon inquiring, I found that she misused the concept of doubling the length. When I calculated the volume of the sphere, all the students were astonished when they saw on the whiteboard that the new volume was eight times of that of the original one. Moreover, from their elementary education, students are often grown up with the concept of generalization that if anything (usually length and weight) is doubled, it results to doubling, and hence the idea of linearity always comes first in their mind. For example, if length x is doubled, it becomes 2x in Algebra. If a line segment of 10 cm is doubled, it results into a line segment of 20 cm. Such habit of mind developed in them provokes them to apply the idea of linearity everywhere in all contexts of mathematics. However, they are unaware that such generalization of algebra may not be applied all cases. Moreover, they are unable to develop their skills of applying algebraic generalization in geometry. For example, if the length and breadth of a rectangle are doubled, will the area be also doubled? Not really! However, students' linear thinking provokes them to act linearly and they apply it everywhere.

Based on Freudenthal (2002), many mathematical concepts are announced by adjectives (p. 10). For example, adjectives belonging to length are long and short, wide and narrow, thick and thin, high and low, far and near, deep and shallow, etc. Such adjectives are used in a certain linear pattern to express a kind of relation between two quantities in mathematics. For example, x is shorter than y; p is as thick as q; m is two times as long as n; etc. The similar patterns are found in case of set, function, weight, area, volume, and everywhere in mathematics. For example, M is a set of all male students in Grade X; A(l, b) is a function of length l and breadth b; its weight is heavier than the other; the area of rectangle is equal to length times breadth; volume of prism equals the product of area of cross-section and height of the prism; etc. When I observed such patterns, I came to realise that mathematics teaching-learning process is based much on the notion of linearity. Moreover, I have also been often practicing linear way of teaching and learning of mathematics all the way from my early days of learning and teaching. As suggested by Freudenthal (2002), "Linearity is such a suggestive property of relations that one readily yields to the seduction to deal with each numerical relation as though it were linear" (p. 267).Therefore, linearity provokes students into such thinking and acting that their success will rule out the possibility of a setback, and they will be trapped into the illusion of linearity. Nonetheless, I don't claim that linearity does not have any contributions in sense making or meaning making process while teaching and learning of mathematics. I also don't claim that I have always practiced linear ways of learning and teaching of mathematics throughout my educational journey. But, I have realised now that knowingly/unknowingly, directly/indirectly, linearity has become a self-evident and intrinsic tool of teaching and learning of mathematics in my pedagogical practices.

That's why; I confess that the illusion of linearity has become a puzzled momentum in my pedagogical practices while reductionism in mathematics education has promoted linearity in teaching and learning of mathematics. I am quite anxious about overuse of linearity due to reductionism in my pedagogical practices if it kills creativity of my students despite its many advantages, – for example, disintegrating the whole into various discrete sets of knowledge and connecting them skillfully, solving problems using facts and rules mechanistically, etc. – thereby helping me think and act in short time, saving time. How did reductionism persuade me to promote linear teaching and learning of mathematics? How can I get out of such illusion of linearity? What are the possible ways of overcoming the hegemony of linearity in my pedagogical practices? What about nonlinear approach of teaching and learning of mathematics? Can I promote nonlinear approach of teaching and learning of mathematics? Can both linear and nonlinear approaches survive together in my pedagogical practices? Can my pedagogical sensitisation help me envision holistic mathematics education? These issues are the basic orientations of my research agenda.

Purpose of the Research Study

The main purpose of the research study was to critically reflect on my pedagogical practices so as to improve them. For this, I excavated my hidden and untold stories based on both linearity and nonlinearity of my teaching and students' learning of mathematics. In this regard, the purpose of my study was to critically explore, re/examine, re/invent and reflect on my pedagogical practices as a conventional teacher, as a teacher-researcher informed by transformative education, and as a practitioner-researcher with transformative education research at my disposal so as to finally envision the holistic mathematics education through transformative education.

Research Questions

To be honest, it was a tough gulp for me to develop research questions. At first, I randomly wrote some questions that meet the main theme of my research agenda. After spending several days and nights, I edited them to four questions. Later on, I changed all the four questions and wrote completely four new questions. However, while developing the chapters I realised that the last two questions were overlapping to each other, and hence I merged them to one. Finally, I had in my hand three research questions which are as follows:

1. As a conventional teacher, in what ways did disempowering features of reductionism persuade me to promote linearity of teaching and learning of mathematics?
2. As a teacher-researcher with transformative sensibility, how do I incorporate non/linearity in the teaching and learning of mathematics so as to reduce my pedagogical ecotone and students' learning ecotone?

3. As a practitioner-researcher with transformative education research at my disposal, how does my pedagogical sensitisation help me envision holistic mathematics education through transformative education?

Significance of the Research Study

According to Tutak, Bondy and Adams (2011), raising the questions about 'the way things are' and wondering how they might be done differently are the habits of those who embrace a 'critical' approach to education (p. 66). Oriented to this notion, I was always 'critical' to reflect, re/examine and re/invent my pedagogical practices throughout the research study – being critical was not being negative, rather I was committed to democratic principles of equity and justice.

Therefore, the research study helped me become a critical learner, teacher, teacher-educator and research-practitioner, and hence I am always concerned about raising my students with critical eye to examine social justice in their world by making them conscious about the fact that mathematics education is not just about scoring good marks in the exams, rather it is also about liberating, enlightening, emancipating, and empowering.

As a teacher and educator, I often have very linear concerns. However, this research study will be useful for both mathematics teachers and students to critically reflect on their practices and examine how learning particular non/linear skills help them understand concepts that will shape their thinking and understanding. Further, this research study will also open space for having a critical discussion among the mathematics teachers on the issue that reductionist approach of teaching and learning gives overemphasis on linearity so that we are trained to assist in this process through a variety of techniques, to organize what comes first and second, and to assess whether or not the students have learned what we intended. Therefore, teachers will be thoughtful on examining their taken-for-granted assumptions and become aware of the false consciousness about linearity in teaching and learning of mathematics due to reductionist mathematics pedagogy.

Besides, referring to a popular adage ‘every coin has its two sides’, teachers will also be conscious about the nonlinear nature of emergent teaching and become thoughtful about implementing nonlinear approach of teaching of mathematics in the classroom together with linear method. Moreover, this research study will be useful for all mathematics teachers to become thoughtful about implementing non/linear approach of teaching and learning of mathematics in the classroom.

Above all, I hope that this research study will be useful for all the people such as teachers, students, novice researchers and parents, and institutions such as schools, colleges and universities, who and which wish to transform practices and systems that routinely disadvantage human beings so as to achieve justice and equity in their worlds through holistic mathematics education.

My Theoretical Referents

What sorts of assumptions guide my personal professional life? Are there any specific systematically organized and tested body of knowledge which is grounded on a system of assumptions, accepted principles and procedural rules established as world-views that analyze, predict or explain the nature or behaviour of phenomena? In this regard, what sorts of theories guide me and my research then? Can I select some grand theories so as to analyze, predict or explain the certain nature or behaviour of my research phenomena? If it is so, then which theories best fit into my research inquiry? These issues created dilemma in my thought process while selecting theories.

However, I had already experienced during my master's research study that there are no any such theories that guide researchers solely throughout the research study. In fact, there were not only lived but also living experiences and contradictions grounded on my personal professional life-world in relation to the communities where I was deeply involved during my research inquiry. I was pretty aware that my beliefs towards certain assumptions and considerations might change according to the time and context. That's why; how could I subordinate and/or neglect those immediate assumptions and considerations grounded on the field of my research study? Nevertheless, I also believed that the well-established grand theories also have impact on shaping my research inquiry.

Despite there were no any grand theories which solely guided my research study and which could explain, predict and analyze certain nature or behaviour of phenomena, I employed three grand theories – *living educational theory*, *transformation learning theory* and *knowledge-constitutive interests* as theoretical referents while conducting my research inquiry.

Living Educational Theory

Everyone gives values to their life. We accept that those values play potential roles in our value-laden living and hence bring about conflict in our lives in this pluralistic society. In the milieu of those living contradictions, education is basically taken to be an interaction among the people, which leads to learning and growth. In this regard, I agree Fromm (1956) that:

> I am on the side of Dewey and others who hold that education is a process which leads to learning for personal and social benefit. Like Dewey, I believe in the value of personal freedom and social justice, and the right of all people

> to live a peaceful and productive existence and enjoy loving relationship (as cited in McNiff & Whitehead, 2002, p. 9).

With this notion, I experienced that my students were not getting the access of authentic learning of mathematics that would guide them for their personal and social benefits. That's why; to create dynamic learning environment, my belief in teaching and learning of mathematics was guided by Whitehead (2008a) who urged that each individual can create their own living theory which explains their educational influence. Here, I also admit that only established theories do not guide our teaching and learning of mathematics. Our living experiences and contradictions play important roles in enhancing our personal philosophy (which is influenced by socio-cultural contexts) towards mathematics learning. In this regard, I recognize Whitehead (2008a) and his contributions in developing my own "Living Educational Theory", which states that "A living educational theory is an explanation produced by an individual for their educational influence in their own learning, in the learning of others and in the learning of the social formation in which they live and work (p. 104)."

In this regard, I took the reference of living educational theory to build *awareness* in me about the question "How do I improve what I am doing?" Therefore, I employed the living experiences and contradictions of mine as researcher and students as key participants as theoretical referents in my research study. Further, I also borrowed the Belle Wallace's action reflection cycle in her work on "Thinking Actively in a Social Context (TASC)" (as cited in Whitehead, 2008b, p. 4). The taxonomy of Belle Wallace in cycle has eight components: Learn from experience (What have I learned), Gather/Organise (What do know about this?), Identify (What is the task?), Generate (How many ideas can I think of?), Decide (Which is the best idea?), Implement (Let's do it!), Evaluate (How well did I do?), and Communicate (Let's tell someone!).

This action reflection cycle helped me improve my pedagogical practices so as to envision authentic, inclusive, and empowering mathematics education in the context of school mathematics because my research study guided by this cycle in finding the outcomes of the question "How do I improve what I am doing?". In this context, I agree with (Whitehead, 1985) that:

> My purpose … is to outline how I think a professionally credible educational theory could be generated and tested from … a form of self-reflective inquiry undertaken by participants in educational contexts in order to improve the rationality and justice of: (a) their own educational practices, (b) their understanding of these practices, (c) the situations in which the practices are carried out (p. 97).

In the mean time, I envisioned that being a professional teacher in schools and university, I would face an academic community (KUSOED, my own school, readers, etc.) when I (as an insider and outsider) along with my students (participants, insiders) would contribute to generating knowledge for improving education within school because the academic community would examine the legitimacy of the claim of knowledge. However, I assumed that I as a teacher-researcher would be concerned to establish a direct relationship between the claim to know what I am doing and my students' educational development.

Transformative Learning Theory

Being a researcher-practitioner informed by transformative education research, I employed transformative learning theory (TLT) as another theoretical referent in my research study. In this regard, I felt its significance in carrying out the whole research study and hence portrayed its growth history to its execution in my research study.

Growth of Transformative Learning Theory

Transformative learning theory (TLT) came to existence after Mezirow and his team researchers conducted a qualitative research study to identify factors that characteristically impede or facilitate women's progress in the re-entry programs in 1975 in the US (Kitchenham, 2008). Mezirow studied 83 US women who were resuming their education or considering employment after a long period of time. Mezirow's theory of learning was influenced by Habermas' (1971) three domains of learning – technical, practical and emancipatory in developing three kinds of knowledge –instrumental, communicative and emancipatory respectively.

For me, transformation means to change in person's worldview by integrating different worldviews into his/her own worldview. Moreover, transformative learning is about *meaning making*, not just like our everyday learning to acquire knowledge. To make meaning is to make sense of experience and when we make interpretation of it to guide decision-making or action, then making 'meaning' becomes learning. Mezirow (1990) elaborated two dimensions of making meaning – *meaning schemes* and *meaning perspectives*. *Meaning schemes* are sets of related and habitual expectations governing 'if-then', cause-effect' and category relationships as well as event sequences. Such expectations are habitual, inherent rules for interpreting. More so, *meaning perspectives* are made up of higher-order schema, theories, propositions, beliefs, prototypes, goal orientations and evaluations, and networks of arguments.

Moreover, meaning perspectives refer to the structure of assumptions within which new experience is assimilated and transformed by one's past experience during the process of interpretations.

Employing TLT as Referent in My Research Study

Based on transformative learning theory as theoretical referent, my research study aimed at improving my pedagogical practices despite there were some disempowering forces (e.g. reductionist pedagogy) into action so as to quantify the outcomes of my students' learning of mathematics! Though, due course of my MEd and MPhil study, I gradually shifted myself from positivist to constructivist teacher, there were still many obstacles to students' meaningful learning of mathematics in the classroom. It raised some questions: Am I a constructivist teacher? Am I doing justice to my transformation in teaching and learning of mathematics? I became thoughtful and sought for the solution. I then asked to myself: Is there any *shift* in my *consciousness*? I re/visited my retrospective and introspective phases of teaching and got insight that "One of the uniquely powerful aspects of transformative learning is the focus on expanding *conscious awareness* of our situatedness in the world or, to put it more simply, our understanding of who we are and who we might yet become, as both individuals and social beings" (Taylor, 2013).

Employing TLT from the Perspectives of Ways of Knowing

In this regard, I found that I could see only the materialistic aspects of my teaching and learning of mathematics but could not realise the non-materialistic aspects of mine and my students as well. Then I sought for a transformation which entails developing a heightened consciousness of the relationship between our outer (material) and inner (non-material) worlds because transformative learning involves using cognitive, emotional, social and (for some) spiritual 'tools' to reconceptualise and reshape this relationship. Since I envisioned an authentic, empowering and inclusive mathematics, using an engaged pedagogy I along with my students engaged in generating knowledge. In this course of knowledge generating process, our epistemic frame comprised *known* from knowers (me and my students) and *knowing*, and our ways of *knowing* was guided by transformative learning.

According to Taylor (2015), transformative learning comprises five distinct interconnected ways of knowing – *cultural-self knowing* (i.e. self realisation), *relational knowing* (i.e. opening to difference), *critical knowing* (i.e. political astuteness), *visionary and ethical knowing* (i.e. over the horizon thinking) and *knowing in action* (i.e. making a difference), all of which helped me develop a heightened consciousness of the relationship between my inner (non-material) world and the outer (material) world. In this regard, *critical-self knowing* helped me understand my own worldviews such as values, premises, frames of references, emotions and ideals governing my social inter/actions; *relational knowing* helped me understand and appreciate the value of reconnecting with the natural world and with the culturally different others' ways of knowing, valuing and being in the world; *critical knowing* helped me understand how our economic and organizational power has historically structured our sociocultural reality especially grade, race, gender and the conventional scientific worldview and thus governs our identities and our relationships with the natural world and with the culturally different other; *visionary and ethical knowing* enhanced me in envisioning through idealization and imagination and dialogue with the culturally different other what a better world should be like; and *knowing in action* encouraged me in consciously developing my capacity to help make the world a better place, committing to making a difference, and taking action locally while thinking globally.

Employing TLT in Coagulated Form

Moreover, transformative learning theory does not derive from a systematic extension of an existing intellectual theory or tradition; rather it is an integration of Mezirow's earlier research and concepts and theories from a wide array of disciplines. Based on this perspective, during the research study, I and my students together generated many forms of knowledge which were used as theoretical referents in my research inquiry when I realised that construction of knowledge generates new knowledge. Based on the notion of Mezirow (1991), and Taylor and Cranton (2012), transformative learning theory is based on constructivist assumptions, and the roots of the theory lie in humanism and critical social theory. It suggests that transformative learning theory is based on the notion that we interpret our experiences in our own way, and that how we see the world is a result of our perceptions of experiences. That's why; during the meaning making process, I and my students were not involved in researching the well-established facts and findings rather we interpreted our experiences (prior knowledge) in our own contexts by critically examining, questioning and revising our perceptions so as to envision and find out new facts and findings.

Based on Taylor and Cranton (2012), humanism is founded on notions of freedom and autonomy and the humanist assumptions are inherent in transformative learning theory. Therefore, if we cannot make the assumptions that people can make choices, have the potential for growth and development, and define their own reality, transformative learning cannot be described. More so, critical social theory plays a key role in transformative learning. The goal of critical social theory is to critique and change society as a whole, rather than explaining or describing it. In a society we uncritically assimilate the dominant ideology which includes the values, beliefs and assumptions from our family, community and culture in a normal and natural way. When we are able to recognize that this ideology is oppressive and not in our best interests, we can enter into a transformative learning process.

In this regard, this conceptual framework of transformative learning theory assisted me throughout my research inquiry in making me and my students aware about the assumption that the dominant ideology of west-centric mathematics was not of our (i.e. me and my students) interests; rather our interest was to develop authentic, empowering and inclusive mathematics that would serve us (me and my students) in our personal and social life (Luitel, 2013).

Knowledge Constitutive Interests

I employed Habermas' three knowledge constitutive interests as theoretical referent in generating or constructing knowledge during my research study, in that, 'interest in general is the pleasure that we connect with the experience of an object in action' (Habermas, 1972). For Habermas, interests are fundamental orientations of the human species and pure interests are fundamental, rational orientations (Grundy, 1987). The rationality determines what counts as knowledge. Thus, the pure interest in reason expresses itself in the form of three knowledge-constitutive interests – technical, practical and emancipatory. These three interests constitute the three types of science by which knowledge is generated and organized in our society, which are empirical-analytic, historical-hermeneutic and critical respectively.

Technical Interest as Theoretical Referent

The technical interest generates objective (instrumental) knowledge through a series of observation and experimentation in a controlled and managed environment. This knowledge is structured according to series of law-like hypotheses by which meaning is made of observations based on hypothetico-deductive logic and genre and which has predictive power that allows us to anticipate what the environment probably will be like tomorrow based upon the experience of what it is like today. Moreover, the question motivated by technical interest is ‘What can I do?’ Since instrumental knowledge is cause-effect, objective knowledge derived from scientific methodologies (Cranton, 2002, p. 6), I now realised that I was mostly guided by technical interest in my retrospective phase of teaching in objectifying knowledge through transmission of instrumental knowledge to my students in a controlled and managed environment. In this study, I employed technical interest as a theoretical referent in assessing how my thoughts and actions were directly/indirectly guided by the notion of technical interest.

Practical Interest as Theoretical Referent

The practical interest generates subjective (communicative) knowledge through interaction among actively involved people. Habermas (1972) stated that the basic orientation of the practical interest is towards understanding. This understanding is not a technical understanding that enables rules to be formulated so that environment can be manipulated and managed; rather it is a consensual understanding among the people actively involved in interaction. The question motivated by the practical interest is ‘What ought I do?’ Communicative knowledge is the understanding of ourselves, others, and the social norms of the community or society in which we live (Cranton, 2002, p. 6). Thus, the practical knowledge gives rise to a false consciousness and a practical teacher plays the role of a Facilitator in the classroom and most importantly, the voices of all students are heard while only the voices of the majority are addressed so as to generate knowledge, thereby subordinating and/or minority of people. That’s why; such knowledge is treated as a ‘false consciousness’. In this regard, I now realised that my thoughts and actions might be directly/indirectly guided by the notion of practical interest during my retrospective and introspective pedagogical practices. In this study, I employed the practical interest in assessing how my thoughts and actions were guided by the notion of practical interest throughout the research inquiry.

Emancipatory Interest as Theoretical Referent

The Emancipatory knowledge is a product of critical reflection and critical self-reflection (Cranton 2002, p. 6). It involves the self-awareness that frees us from constraints. For Habermas, emancipation means ‘independence from all that is outside the individual and is a state of autonomy and responsibility’ (Grundy, 1987). Emancipation is possible only when there is an act of self-reflection. The role of an emancipatory teacher is to allow all students raise their voices so that the voices of each and every student is heard and addressed in the classroom throughout meaning making process, thereby enabling both teacher and students to change the constraints of the learning environment through their shared struggles. The acquisition of emancipatory knowledge is transformative. According to Kemmis and Fitzclarence (1986, p. 72), the emancipatory interest strives for empowerment, rational autonomy and freedom, emancipating others from false ideas, distorted forms of communication and coercive forms of social relationships which constrain human action (as cited in Fraser, & Bosanquet, 2006, p. 281). In this regard, I employed the notion of emancipatory interest to develop awareness in me as well as in students about the hegemonic false consciousness such as many disempowering forces (e.g. reductionist pedagogy, west-centric worldviews, etc.) throughout the research study. Moreover, the emancipatory interest simply guided me while conducting as well as writing the research study from the capacity of theoretical referent.

Chapter Summary

In this chapter I discussed how my research agenda emerged from personal professional context and how I problematized my practice. After stating the purpose of my research study, I reflected upon my retrospective and introspective pedagogical practices and envisioned my prospective pedagogical practices, thereby formulating three research questions. After stating the significance of the research study, I discussed about three theories of referents – living educational theory, transformative learning theory and knowledge constitutive interests that guided me throughout the research study.

CHAPTER II

PAVING MY RESEARCH QUEST

In chapter I, I have portrayed my journey of exploring research questions arising from the key research problems of reductionist mathematics pedagogy. This chapter portrays how I paved my research journey. Therefore, I have developed this chapter with the topics in the following order: Delving into Research Methods in Education: I Explored All Avenues; Multi-Paradigmatic Research Design Space (Interpretivism: Looking Through Others' Eye, Criticalism: Empowering Self and Others and Postmodernism: A Window to Look into Others' Mind and Heart); Auto/ethnography as Research Methodology; Writing Narrative as a Method of Inquiry; Use of Slash, Multiple Logics and Genres, My Quality Standards; My Ethical Standards; and Chapter Summary.

Delving into Research Methods in Education: I Explored All Avenues

Since the time I started my journey of master's study from 2007 (February), I gradually got acquainted with both the quantitative and qualitative research methods in education. Since I was a student from the pure science (BSc) and joined the master in mathematics education, I had no any idea about what research was all about and how it was conducted. In course of journey of my master's study, I got an opportunity to learn the course 'Research Methods in Education'. After having much discourses in the classroom about the research methods and reviewing many literatures, I found that quantitative research is a positivist research that is carried out with technical-procedural steps and concerns with such facts and findings that preserve objectivity, replicability and casualty, while the qualitative research considers all aspects of researchers, research participants and research field. That's why; I was derailed from the path of positivist research methods and gradually fascinated by the qualitative research methods. Cohen, Manion and Morrison (2011) formulated how positivist quantitative research is carried out:

> A quantitative research proceeds through literature review, generating and formulating the hypothesis/the theory to be tested/the research questions to be addressed, designing the research to test the hypothesis/theory (e.g. an experiment, a survey), conducting the research, analysing results, considering alternative explanations for the findings, reporting whether the hypothesis/theory is supported or not supported, and/or answering the research questions, and considering the generalizability of the findings (p. 117).

Moreover, I was not expert in computer skills in the beginning of my master's study and it was very tough time for me to conduct positivist research using SPSS[4] in computer. When I deeply studied, my first observation was that such research method neglects some data as outliers so as to manipulate the original data for a desired result. At this stage, this notion of positivist research method disturbed me a lot because at that very moment came in my mind those very weak students of my school, whom I had been putting all of my efforts to improve their skills of mathematics learning. I feared if positivist research method would provoke me to disqualify such very weak students as outliers and generalize the result without addressing them.

As time passed, I realised the fundamental differences between the natures of knowledge that both the research methods generate or construct. In positivist research, the research is conducted for finding out the everlasting universal knowledge as an object through series of scientific observations and experimentations while in qualitative research, knowledge is generated or constructed through meaning making

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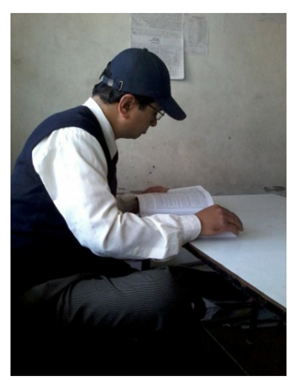
[4] Statistical Package For Social Sciences

process among the people who are deeply involved in communication and interaction, and the knowledge so obtained through interpretations among the people is subjective which is corrigible and revisable according to the time and context. Regarding qualitative research, Denzin and Lincoln (1994) write the following definition:

> Qualitative research is multi-method in focus, involving an interpretive naturalistic approach to its subject matter . . . qualitative researchers study things in their natural settings attempting to make sense of, or interpret, phenomena in terms of the meanings people bring to them. Qualitative research involves the studied use of and collection of a variety of empirical materials . . . that describe routine and problematic moments and meaning in individuals' lives. (p. 2)

On the basis of my deep involvement in qualitative research during and after my master's study, I reviewed the local literatures of Luitel (2003, 2009) many times and got acquainted with multi-paradigmatic research design under transformative education research. Later on in 2011, I conducted my master's research inquiry using auto/ethnography as a research methodology without using any paradigm as I had not got clear picture of paradigm at that time though multi-paradigmatic research design guided my research study throughout.



After joining MPhil study in 2014, I got frequent opportunities of learning about the multi-paradigmatic research design under transformative education research. *I explored all avenues.* I fought tooth and nail to understand the meaning of the notion 'paradigm' which was not a new for me though. I dug out even the demon's den to design the research in a congeal form. But I needed clarification in my understanding of this notion because I had to select some prevailing paradigms that would be guiding my research. I reviewed again some research papers and tried to get some idea that a paradigm, in general, is a worldview that governs our research and practice in a field. Willis (2007) explains that "A paradigm is a comprehensive belief system, world view, or framework that guides research and practice in a field" (p. 8). Further, I came to realise that research is always guided by some philosophical assumptions, and from the philosophical standpoint, a paradigm is governed by three terms – ontology, epistemology and methodology. I upgraded my ontological and epistemological assumptions and methodological consideration so as to finally embrace the multi-paradigmatic research design in my research study.

Since my aim was to explore and critically assess my pedagogical practices, I thought that the multi-paradigmatic research design could be the one that would help me look at the bigger picture of the nature of my ways of knowing and becoming. In due course, when I reviewed Luitel (2009), I realised that ontology and epistemology play key roles in selecting an appropriate research methodology. Hitchcock and Hughes (1995) also suggest that there is a logical procedural sequence in the research process. According to them, ontological assumptions give rise to epistemological assumptions, which, in turn, give rise to methodological considerations, and which finally give rise to instrumentation and data collection (p. 165).

In this way, I selected multi-paradigmatic research design under which I chose three paradigms – interpretivism, criticalism and post-modernism.

Multi-Paradigmatic Research Design Space

Since my aim of the research study was to explore and critically assess my pedagogical practices, I embraced multi-paradigmatic design space (Willis, 2007; Taylor, 2008; Luitel, 2009) under transformative research informed by the multiple realities (*ontology* driven by relativist) and subjective knowledge (*epistemology*: knower and subject create understanding) (Denzin, & Lincoln, 2000).

Although I see the value of objectivity – an ontology driven by realism, my ontological assumption driven by relativism is that there exist multiple realities opposing to unique, objective, universal reality. I believe that there is no any reality outside of social construction. My epistemological assumption is that knowledge is subjective; no objective 'reality' or 'truth' is out there residing somewhere to be discovered; rather realities are constructed by social actors through social interaction. Thus, knowledge is co-constructed by researcher (me) and researched (participants) and is emergent from social interaction. More so, I hold an assumption that a single reality is not an ultimate truth for me rather reality is an ever-changing process because of my changing perspectives, beliefs, and perceptions of the world.

However, I also admit that in due course of research study, I was also driven by positivist (realist) ontology and epistemology so as to dig out the objective reality of my pedagogical practices.

On the very basis of these ontological and epistemological assumptions, I interacted with *self* and *others* (e.g. students, parents, teachers, Principal of the school, etc.) to realise the multiple realities; I involved myself in identifying and transforming socially unjust structures, beliefs and practices; and I represented what exactly was going on in my mind – my thoughts and feelings. In this context, I employed three key paradigms – interpretivism, criticalism and post-modernism under the multi-paradigmatic research design space to carry out my research study.

Interpretivism: Looking Through Others' Eye

Since I had already realised that the positivist (quantitative) research method gives rise to the normative paradigm which contains two major orienting ideas

(Douglas, 1973): first, that human behaviour is essentially rule-governed; and second, that it should be investigated by the methods of natural science (as cited in Cohen, Manion and Morrison, 2011, p. 17), I derailed myself from its path and employed interpretive research paradigm so that I could interact with my research participants, reflect upon my actions, and interpret the multiple realities to make meaning of them.

I knew that I was a teacher who often enjoyed transmitting knowledge to the students as passive recipients. So, I had to transform myself to "a teacher as a researcher" (McKernan, 2008) through action and reflection into my own practice, and had to "understand the culturally different 'other' by 'learning to stand in their shoes', 'look through their eyes' and feel their pleasure or pain'" (Taylor & Medina, 2011). Then, becoming *a teacher as researcher* I had a challenge of understanding the students' culture from their eyes and hence chose the interpretive research paradigm as one of the key paradigms for my research because it is concerned primarily with generating context-based understanding of people's thoughts, beliefs, values and associated social actions (Taylor, Taylor, & Luitel, 2012). Its social constructivist epistemology facilitated me not only in unfolding my subjectivity while shaping the process of the inquiry but also in the act of my interpretation of the students' meaning perspective. Henceforth, throughout my research inquiry, I exercised interpretive research paradigm to focus on the centrality of meaning making and understanding of *self* and *others* (e.g. students, teachers, Principal of the school, etc.) so as to improve my pedagogical practices.

I feel that it is quite far from reaching into others' world unless the researcher as a fisherman swims in the pond of participants as fish. Because I as a teacher researcher had to build rich local understanding of the life-world experiences of both mine and students and of the cultures of the classroom, school and the communities they served, I as an ethnographer immersed myself within the culture of my research participants through a prolonged process of interaction using ethnographic methods of informal interviewing, participation observation and establishing ethically sound relationship. As an interpretive researcher I engaged into a deeper understanding of the social, political, historic and economic forces to find out possible ways of improving my pedagogical practices, the curriculum policies of mathematics education and the policies of the school where I immersed throughout my research inquiry.

As an interpretive researcher, I constantly asked myself: What is the influence of my own past and present values and beliefs in interpreting the thoughts and feelings of my research participants? What hidden assumptions are constraining or distorting the way I make sense of the other? More so, interpretive inquiry also helped me engage as a reflexive practitioner in developing enhanced understanding of the life-worlds of my students as research participants by raising awareness in me about the questions such as: Who are these students who sit before me? Who is the self that teaches? (Palmer, 1998). Such awareness in me, after all, guided me throughout the research study to adopt more student-centered pedagogies such as constructivist approaches of teaching and learning.

Criticalism: Empowering Self and Others

In my research study, I employed the paradigm of criticalism with the aim of examining hegemonic mathematics pedagogies. When I critically reflected upon my own pedagogical practices (see problem statement), I found that my retrospective phase of teaching and learning were mostly influenced by ‘outward criticality’– a dualistic attitude that perceives the problem to exist exclusively outside of the individual (Luitel, 2009). The paradigm of criticalism thereby assisted me to find out that my critique was much deviated towards outsiders.

Gradually, I realised that being a teacher as researcher I should look for critical selfhood (i.e. inward or self-reflective critically) so as to become more conscious in transforming my own pedagogical thoughts and practices. This paradigm of criticalism helped me in excavating many hidden and/or seen problems and their possible solutions related to my pedagogical practices. In so doing, I critically reflected upon my roles as a reductionist teacher who was himself not satisfied with the linear ways of teaching and learning of mathematics (see Chap. III), and as a radical teacher who was passionate to employ empowering pedagogy but could not incorporate many aspects of nonlinear teaching and learning of mathematics (see Chap. IV & V).

In the mean time, I had many challenges of empowering my students who should become more imaginative and critical thinkers capable of addressing the question: Whose interests are not being or should be served by particular social policies? In this regard, the critical research paradigm facilitated me to address such issue by enabling me to practice ‘deep democracy’ which involves identifying and transforming socially unjust social structures, policies, beliefs and practices (Kincheloe & McLaren, 2000). More so, critical researchers usually go beyond interpretive understanding of the social world to adopt an interventionist role and redress various social discriminations through advocacy and other forms of active engagement (Taylor, Taylor, and Luitel, 2012). Therefore, during my research study I played the role of interventionist against the disempowering forces (e.g. reductionist mathematics pedagogy, culturally decontextualised mathematics curriculum, social injustices, etc.) advocating the active engagement of students in a meaningful learning of mathematics. For this, I interacted with students and school stakeholders in a regular basis by raising the voices against such disempowering forces through a dialogical writing. I also encouraged my students in writing constructive comments with regard to the engaged pedagogy and empowering mathematics curriculum during my research inquiry.

As a critical researcher, while writing narratives, I raised my own critical consciousness (Brookfield, 2000) and constructed a moral vision of a better society in the school. My role was a change agent who argues for and leads the way towards a more equitable, fair and sustainable society in the school.

Most of all, the paradigm of criticalism helped me focus on raising my conscious awareness about the established values and beliefs that underpinned my natural teacher-centered classroom roles (Taylor, 2008). During the research inquiry and writing, this paradigm helped me stimulate my creative thinking about designing pedagogy, curriculum and assessment that would be more student-centered, inquiry oriented, culturally sensitive, community-oriented, socially responsible, etc. Since the aim of my research study was to focus mainly on improving my pedagogical practices, I, thus, employed this paradigm to raise awareness about my pedagogical practices so as to find ways of improving students' learning of mathematics. Nevertheless, pedagogy, curriculum and assessment all are intersubjective and hence I constantly raise voices against the culturally decontextualised mathematics curriculum, controlled (disengaged) pedagogy and standardized assessment practices that were influencing my pedagogical practices and students' learning throughout the research study. In this process, I also constantly made parents and school's stakeholders aware of various influencing factors that could hinder as well as enhance students' learning of mathematics. Thus, the paradigm of criticalism helped me empower self and others during the research study.

Postmodernism: A Window to Look into Others' Mind and Heart

The paradigm of interpretivism helped me to interact with *self* and *others,* and that of criticalism empowered me to critically reflect upon the practices of *self* and *others*. However, I believe that every aspect of life in our everyday reality is not pre-given or pre-determined, and they are constructed and reconstructed through our subjective lenses (Luitel, 2009, p. 29). There is no window in our head that allows another person to look directly into our minds and see 'exactly what we mean' (Taylor & Medina, 2011). However, the paradigm of postmodernism played a key role of such window that helped me and others look into one others' minds and hearts – I could look into the minds and hearts of students, teachers, parents, school stakeholders, etc. and so could they look into my minds and hearts – by representing my/their thoughts and feelings through various means of communication (e.g. language, art, gesture, etc.) during my research study.

Moreover, the paradigm of postmodernism has opened door to the discipline such as Arts in excavating and presenting narratives in the context of pluralism and differences in our society. It has made available many new forms of representation such as (i) *literary genres* of impressionist writing, autobiographical writing, storying, poetry, ethno-drama, screenplay and fiction, and (ii) *visual imagery* such as film, painting, sketching, dance and photography (Knowles & Cole, 2008; Prendergast, Leggo & Sameshima, 2009). While drawing on and writing my narratives, this paradigm of postmodernism helped me excavate my lived and living experiences and contradictions capturing every possible moments of my pedagogical practices throughout the research study.

While presenting my narratives, I did not solely follow the conventional linear way of reasoning (proportional, deductive and analytic logics and genres) rather being an interpretive and critical researcher, I employed alternative-inclusive logics and genres such as dialectical logics and genre (synthesis of contrary viewpoints), poetic logics and genre (capturing ineffability), narrative logics and genre (diachronic representation of research process) and metaphorical logics and genre (employing analogies and images to expand conceptual possibilities).

Therefore, throughout the research study the paradigm of postmodernism became a window for me to look into other's mind and heart so that I could capture inaccessible and ineffable everyday realities (e.g. beliefs, attitudes, values, emotions), and present them using various modes of reasoning.

Auto/ethnography as Research Methodology

"Action speaks louder than words." This popular adage was a basic orientation to conceptualising, conducting and accomplishing my research study. I faced many *ups and downs*, crossed many *odd times* and played with many *reflexes* that came across my journey of learning different research methodologies. I was whirled up by the stirring storms of various research methodologies while reading various research papers to conceptualise them.

My story relating to auto/ethnography began from the time of my master's study. It became a basic tool for saving me from the "crisis of representation" (Spry, 2001) when I was a novice practitioner-researcher of multi-paradigmatic research design space. Not only I, the whole research world was dominated by the positivist research design, and I also knew that everything in reality is not commensurable e.g. axiological and aesthetical dimensions of people incorporating beliefs, attitudes, values, emotions, etc. Knowingly/unknowingly, the decision of choosing auto/ethnography was my radical response to the traditional approach of research methodology so as to "perform my methodological and textual praxes" (Spry, 2001), which privileged me "as a researcher over the subject, method over subject matter, and maintain commitments to outmoded conceptions of validity, truth, and generalizability" (Denzin, & Lincoln, 1992). Moreover, my dissatisfaction in the conventional positivist research methodology also influenced me to choose auto/ethnography as research methodology.

I chose auto/ethnography combining both my autobiographical impulses and ethnographic moments and employed them dialectically throughout the research study. In this regard, auto/ethnography assisted me "in researching and writing that helped me in describing and systematically analyzing (*graphy*) my personal experience (*auto*) in order to understand cultural experience (*ethno*)" (Ellis, Adams, & Bochner, 2011), and treated my research study as a political, socially-just and socially conscious act by challenging the canonical ways of doing research and representing others (Spry, 2001) throughout my research inquiry.

Luitel (2009) helped me articulate *auto/ethnography as a textual praxis* to signify the textual representations of my personal experiences in my cultural context, and *auto/ethnography as a methodological praxis* in generating creative and layered understandings of issues. In this way, my understanding of auto/ethnography both as a methodological and textual praxes assisted me throughout the research study

Above all, I chose auto/ethnography as research methodology for my research project so as to generate textual representations of my lived and living experiences and contradictions which became my key bases for building up the notion that knowledge can be constructed through them. Moreover, auto/ethnography as research methodology passes through several ways of knowing such as "interpreting, self-reflection, deconstructing and evocative storying, all of which seem to arise mainly from interpretivism, criticalism and postmodernism (Ellis, 2004).

In the research study, I employed three key features of autoethnographic text: performative, dialogic and genre, and pedagogic enablement for the thickness and richness of texts and textuality (Luitel, 2009). The performative feature of my autoethnographic text not only helped me to construct narratives of my experiences of professional-cultural situatedness, but will also invite readers to perform imaginatively and creatively my texts in their practical lifeworlds. Whilst the dialogic and genre feature of autoethnographic text helped me write evocative and interactive stories of my lived and living experiences and contradictions and hence will offer spaces for readers to reflect upon their own deep-seated pedagogic values and beliefs, so far. Similarly, the pedagogical enablement feature of auto/ethnography ensured in constructing stories (i) that presents genuine issues of mathematics teaching and learning, and (ii) demonstrating ways of articulating the emancipatory social solidarity in transformative pedagogical practices in mathematics education.

Thus, auto/ethnography facilitated my inquiry as an insider's methodology in which my personal and professional lived and living experiences and contradictions become the key basis of my research inquiry. I believe that auto/ethnography is a method of expressing one's personal experience standing in the midst of cultures (Shrestha, 2011). In my understanding, auto/ethnography is the integration of autobiography describing the self milieu and ethnography describing cultural milieu.

Here is a poetic logic and genre to conceptualize auto/ethnography as a method of inquiry.

Me As An Auto/ethnographer

I want to feel what you feel.

I want you to feel what I feel.

I want my story be palpable to you too.

I want my stories make things *present.*

I want my stories save all of us.

I want to be a complete member in the social world.

I am reflexive to produce ethnographic textual data

Within my personal experience and sense making process.

My reflexivity raises awareness to connect to the research field.

I am dialogic and dialectical.

My self-consciousness is representational as a story teller.

My insight is both a doorway and mirror to see *others* from *self.*

I am visible, active, and reflexively engaged in the data texts.

I am a visible social actor for understanding the social world being observed.

I incorporate my own feelings and experiences into my story as vital data

To construct meaning and values in the social worlds I investigate.

My subjective experience is fully acknowledged and utilized.

Thus, I am an auto/ethnographer.

Writing Narrative as a Method of Inquiry

As a mathematics teacher I have lived many stories of my pedagogical practices, some of which I have told consciously to the world and some are yet to unfold to the world. Thereby, I used narrative inquiry to seek for such told and untold stories of mine and people involved with my professional life-world that they including me were unaware, and hence further I explored the underlying assumptions that they embody. According to Clandinin and Rosiek (2007), the lived and told stories of human beings fill our world with meaning and enlist one another's assistance in building lives and communities (p. 35). Thus, narrative researchers hold the assumption that the story is a fundamental unit that accounts for human's lived and living experiences and contradictions.

As a narrative inquirer, I worked with my research participants' consciously told stories of which they were unaware. I was fully aware if my participants would construct fake stories that support their own interpretation excluding their own identities and cultures. In this regard, narrative inquiry provided me a window to explore the assumptions inherent in the shaping of those stories of the participants. I constantly interacted with my participants to excavate the underlying assumptions of their stories, made meaning after interpretation and constructed my evocative stories throughout the research study. According to Clandinin and Connelly (2000), narrative inquiry is a way of understanding experience through collaboration between researcher and participants over time in a place or series of places, and in social interaction with milieus. In this regard, narrative inquiry allowed me as a researcher to present experiences holistically in their complexity and richness. Throughout the research study, narratives became powerful tools that helped me to present the lived and living stories of mine and students in a meaningful way.

Therefore, narrative inquiry helped me create such stories that invite readers to read them thoughtfully. In this regard, creative imagination played a key role in excavating and presenting the stories of my pedagogical practices. In fact, without imagination it was almost impossible for me to create contextual stories that would have meanings to the readers. In this regard, Luitel (2009) asserts that narrative imagination is useful for telling the researcher's contextual tales inextricably related to people, places, times and events, thereby helping readers to generate meanings and understanding about the pedagogical realities that are depicted through texts (p. 41).

Finally, in my research study, I employed narrative imagination to get information that my research participants did/not consciously know about themselves and their inherent ability of learning mathematics. In so doing, the interpretation of stories of students allowed me to draw on the underlying assumptions, which I unfolded to the world in the form of stories. Throughout the research study, I fought tooth and nail to excavate such stories of my pedagogical practices that would invite readers and provoke them to think mindfully. To be honest, I was quite often in dilemma while selecting the stories that had sense and meaning for the research inquiry. However, I kept on writing narratives of mine as a researcher and students as research participants and interpreted them so as to make meaning of them. Finally, writing narrative as a method of inquiry helped me present the deSired stories my pedagogical practices during the research study.

Use of Slash (/)

As stated by Luitel (2017), “As a matter of symbolism, I have used slash (/) to refer to the dialectical nature (interactive, synthetic, seemingly oppositional, mutual dependence) of notions embedded in my textual performance” (p.3). In the tension between ‘either/or’ dualism, I have realised that there should be a dialectical relation between two opposite or related notions such as ‘day and night’, ‘happy and sorrow’, ‘pure and impure’, ‘linear and nonlinear’, ‘examine and reexamine’, ‘invent and reinvent’, ‘autobiography and ethnography’, ‘objective and subjective’, ‘positivist and constructivist’, ‘contextualisation and decontextualisation’, ‘contextualisation and recontextualisation’, ‘construction and deconstruction’, ‘absolute and fallible’, ‘certain and uncertain’, ‘self and other’, ‘and and or’, and so on. In this regard, I used slash (/) to represent a dialectical relation between the two opposite or related notions valuing both the notions, for examples, auto/ethnography, de/contextualisation, re/contextualisation, de/construction, non/linear, re/invent, re/examine, im/pure, and/or, as/for, etc.

Multiple Research Logics and Genres

Oriented to the artistic and aesthetic sensibilities of the paradigm of postmodernism, I began to realise that I acquire multiple selves and characters, similarities and differences in my personal professional lifeworlds. To represent such plurovocality, I gradually felt that my epistemic journey could not be solely accounted for by both the paradigms of interpretivism and criticalism. Therefore, inspired by artistic and aesthetic sensibilities of the paradigm of postmodernism, I employed multiple logics and genres with an emphasis on multiple ways of knowing.

Therefore, drawing on Luitel (2009), I employed five different research logics and genres and genres in multiple ways enriching my multi-paradigmatic research inquiry into the problems of pedagogical practices faced by teachers and students.

a) Hypothetico-deductive logic and genre: I intentionally used this logic and genre and genre to excavate the underlying assumptions of the reductionist (linear) mathematics pedagogical practices. The conventional hypothetico-deductive logic and genre of the positivist research paradigm comprises of three logics and genre, namely, propositional, deductive and analytical (Laudan, 1996; Luitel et al., 2009).

Through propositional logic and genre, I explored how I was confined to the longstanding hegemonic definite and finitude propositions of reductionist pedagogy that time again provoked me to apply the “reward and punishment” ideology of behaviourism subordinating and /or neglecting the ideology of constructivism. Moreover, propositional logic and genre persuaded me to largely ignore the value of contextual teaching and learning of mathematics, thereby provoking me to employ linear pedagogical practices.

Similarly, deductive logic and genre helped me explore how I was often confined to apply "top-down" method of teaching. Moreover, deductive logic and genre provoked me to follow the process of moving down from unchanging ethereal principles to context-based examples as if the latter are always at the mercy of the former (Goldstein & Brennan, 2005).

I also explore how analytical logic and genre was at its supremacy while implementing especially the various engaged pedagogies based on theories of constructivism. More interestingly, I was always provocative due to analytical logic and genre to compartmentalize the mathematical conceptual constructs into a number of components thereby privileging a few of those categorical components (Wolcott, 2001), thereby subordinating and /or nonlinear teaching and learning of mathematics.

Above all, I used the hypothetico-deductive logic and genres to explore issues, phenomena and themes of my longstanding reductionist pedagogical practices (see Chap. III) while I could not undermine its longstanding history in the field of research. That's why; I used its mild form while portraying narratives in the chapters IV and V.

b) Dialectical logic and genre: I employed dialectical logic and genre to minimize contradictions instilled in 'either/or' dualism endorsed by hypothetico-deductive logic and genre, by promoting synergetic complementary world views (integrative, holistic and inclusive) (Luitel, 2009). Moreover, various forms of dialogic and genre assisted me in reducing the tensions between linear and nonlinear teaching and learning of mathematics thereby promoting the synergetic pedagogies that give more emphasis on student-centric (explorative, contextual, cultural, critical) teaching and learning to develop a vision for empowering mathematics education in Nepal (see chap. IV & V).

c) Metaphorical logic and genre: Metaphorical logic and genre enabled me to engage in multi-schema envisioning, using elastic correspondence between conflicting schemas, in order to capture the complexity of a phenomenon (Lakoff, & Johnson, 1980). I employed multiple epistemic metaphors to lessen the tensions of dualisms and explore the meanings, concepts and ideas hidden in 'either/or' dualisms (Luitel, 2009). Moreover, this logic and genre assisted me to offer a platform for thinking and acting through perspectival 'as-thoughs' in order to minimize an extreme essentialism embedded in the positivistic research tradition. Above all, it helped me project one landscape of schema profiles onto another landscape of schema profiles, essentialising some of the imageries such as culturally responsive teaching and learning, social construction of mathematical knowledge, etc. by questioning the narrow objectivism and extreme subjectivism for exploring various meanings of embodied contextual mathematical concepts, thereby helping me to develop a vision for holistic mathematics education in Nepal.

d) Poetic logic and genre: Throughout my research inquiry, poetic logic and genre became a natural way of interacting self with others and hence assisted me in exploring non-real, felt, mythical and imaginative realities neglected by hypothetico-deductive logic and genre (Luitel, 2009) thereby promoting a relational approach to dealing with different mathematical concepts. More so, it helped me develop classroom as a site for co-generating mathematical knowledge from personal, social and cultural milieus of students. In Eastern dictum poetic language can organize a marriage ceremony between water and fire, divine and demon, safety and danger, soul and body, etc. Similarly, I tried to organize a marriage ceremony between linear and nonlinear teaching and learning of mathematics via poetic logic and genre. Above all, poetic logic and genre helped me understand and valuing my own and students' ineffable values (emotions such as passions, joys, sorrows, etc.) thereby acting justifiably in different situations, deconstructing the longstanding hegemonic assertive dull mathematical language games.

e) Narrative logic and genre: In my research, I used narrative logic and genre as an important means for thinking through multiple dimensions of lifeworlds (Clandinin & Connelly, 1998). Narrative logic and genre helped me to promote mythos-centric thinking that integrate place, people, action and time in generating research texts rich in cultural-contextual knowing, being and valuing (David, 2006).

My Quality Standards

Since the quality standards of validity and reliability are the key regulators in positivistic research, my research inquiry informed by a multi-paradigmatic design space cannot be judged by these quality standards. Moreover, the quality standards of validity and reliability are almost irrelevant for judging the quality of my research process and product. Under the positivistic paradigm, validity indicates whether the means of measurement are accurate and whether they are actually measuring what they are intended to measure, while reliability indicates whether the results are consistent over time and can be reproduced under same circumstances through the same instruments. But, this is more likely extraneous to judge the quality of the research inquiry informed by multiple paradigms, because instruments under positivism cannot measure the aesthetical and axiological aspects of research participants and researcher.

Let me then explain briefly how the quality of my research were regulated by the following set of standards arising from the paradigms of interpretivism (transferability), criticalism (pedagogical thoughtfulness and critical reflexivity), and postmodernism (illuminating and verisimilitude) (Luitel, 2009).

a) Transferability: By transferability, a research activity or its product can be transferred to another setting or context by identifying similarities and dissimilarities between the researched and the would-be research site (Guba & Lincoln, 1989, 2005). The notion of transferability is not about the replicability of the entire research program; rather it is about the adaptability of research aspects to a new context (Luitel, 2009). Thus, through the quality standard of transferability under the paradigm of interpretivism, I attempted to provide rich details of pedagogical contexts, events and moments that I have experienced while implementing the teaching and learning theories in the classroom so that the readers will recognise the transferability of my research contexts to their own educational contexts. More so, my contexts of envisioning empowering (inclusive) pedagogy will also be transferable to the contexts of the readers.

b) Pedagogical thoughtfulness: The quality standard of pedagogical thoughtfulness arises from phenomenological-hermeneutical traditions and addresses the extent to which present and future readers of my texts are evoked to question, reflect and examine their own pedagogical practices (van Manen, 1991). The standard of pedagogical thoughtfulness under criticalism is about the likelihood of teachers and teacher educators becoming aware of deep-seated assumptions guiding their beliefs (Luitel, 2009). Thus, through this quality standard in my research I attempted to generate evocative, perspectival and dialogic and genre texts so that readers will engage in my research texts and reflect upon their perspectives on the pedagogical issues discussed in my research.

c) Critical reflexivity: The standard of critical reflexivity entails the notion of exposing myself as well as being self-conscious of my own (unfolding) subjectivity, thereby being aware of the limitations of my chosen epistemology, methodology and theoretical referents (Denzin, 2003b). Drawing on Luitel (2009), under the critical research paradigm, I maintained the quality standard of critical reflexivity by (i) making the process of interpretation visible to readers; (ii) critically reflecting upon my assumptions as a teacher-researcher; and (iii) consciously and critically reflecting upon my evolving subjectivities (false consciousness) throughout the process of research inquiry.

d) Illuminating: The quality standard of illuminating is about the extent to which meanings of issues under investigation are enriched, deepened, made vivid, and made more complex (Barone, 2006, 2007; Barone & Eisner, 2006). Through this quality standard of illuminating under postmodernism, I tried my best to illuminate significant research issues by accounting for their enrichment, vividness and complexity via narrative, reflective, performance, poetic and non-linguistic logic and genres through self-consciousness and reflexive writing styles (Luitel, 2009).

e) Verisimilitude: The quality standard of verisimilitude is a radical departure from the positivistic research standard of objectively True test (Luitel, 2009). I do not claim that my stories and vignettes embody objective Truth, rather through this quality standard of verisimilitude under post-modernism, I have written narratives and stories in a way that seems to the readers of my research texts to be realistic, plausible, or believable (Taylor, & Medina, 2011). More so, this standard of verisimilitude will be judged by depicting my lived and living experiences and contradictions honestly and truthfully in my narratives and stories.

My Ethical Standards

Born and grown up in a religious family, I am always regulated by the Hindu dictum “Never do harms to others! Do work for human good!” Now, I am in a position to conduct a research for human good. Being a human researcher, I have to interact with fellow human beings and all human interaction has ethical dimensions. However, *ethical conduct* in human research is more than simply doing right thing. It involves acting in the right spirit, concerning for one’s fellow human beings. But, a human research can involve significant risks and there is a possibility of going things wrong.

In this regard, I needed some ethical standards so as to preserve the rights, values, needs, and desires of my fellow human beings, without having any intended personal fulfillment. Thus, being a human researcher, I recognized some ethical standards that regulated my research study based on Luitel (2009).

a) Ethic of care: An ethic of care involves a deep and committed relationship that is based on mutuality, relatedness and trust among people (Luitel, 2009). In my research, I took up such ethical position in three folds: First, while conducting my research inquiry, my ethical position took on an axiological standpoint to speak for my research participants who needed to be cared, especially when they were oppressed from linear teaching and learning of mathematics. Second, while constructing narratives, my ethical position preserved anonymity of all the people (e.g. students, teachers, parents, Principal and Founders of the school, etc.) who directly/indirectly involved in the research inquiry by using pseudonyms and model characters so as to represent their definite common attributes and qualities. However, I opened their anonymity only their oral and written consent. Third, I carefully exposed and involved myself so as to save myself from vulnerability for my own safety and care during and after the research study.

b) Ethic of civic transformation: An ethical and moral obligation as an educational researcher is to abide by the purpose of civic transformation (Denzin, 2003a). I believe that mathematics education is a civic enterprise. Through this ethical and moral obligation, my vision of empowering mathematics education through nonlinear pedagogy (inclusive, empowering and engaged) will contribute to raising civic awareness about their possible roles in establishing a dialectical relationship between two dualistic ideologies of linear pedagogy and non-linear pedagogy of mathematics. Considering conventional teachers as responsible civics, I constructed my evocative narratives about the traditional (positivistic) and constructivist's approaches of teaching and learning of mathematics in the classroom so as to raise a civic awareness in them for transformation.

c) Ethic of responsibility: My research was abided by what Levinas calls an ethic of responsibility (Blades, 2006). Levinas argues that ethics is the first philosophy of human beings because in the absence of ethical responsibility social interaction, mediation and other inter-subjective endeavours are less likely to materalise. While selecting research problem this ethic of responsibility drove me towards Nepali students and teachers who have been suffering from the problems of traditional, linear, and disengaged reductionist mathematics pedagogies, and that this ethic of responsibility also abided me within the meaningful social interaction with the students, teachers, parents, and the Principal and Founders of the school.

d) Ethic of compassion: According to Eastern Wisdom tradition, an ethic of compassion entails concerns about and desire to alter the suffering of others (Luitel, 2009). In my research, I employed an ethic of compassion to reduce or change the sufferings of students produced by disempowering forces such as conventional (linear, disengaged, reductionist) mathematics pedagogy, culturally decontextualised mathematics curriculum, Principal and Founders of school, and parents, which directly/indirectly have been compelling students to suffer from daunting experiences during learning of mathematics in the classroom. Therefore, my ethic of compassion persuaded me to empathise with sufferings of my students so as to make them feel secure in the classroom for meaningful learning of mathematics. More so, this ethic of responsibility also drove me while writing narratives through which I was able to offer insights into the implicit sufferings of students and teachers due to unjustifiable epistemic and pedagogical assumptions of culturally decontextualised mathematics education.

Key Message of the Chapter

This chapter II chapter began with the exploration of research methods and methodologies by articulating why and how I employed three key research paradigms – interpretivism, criticalism and postmodernism under multi-paradigmatic research design space.

In the dualistic research world, respecting the values of both realism and relativism, I played a dialectical role between objective and subjective realities so as to excavate ontological and epistemological assumptions. More so, I could engage in excavating multiple realities through social interaction between me and research participants. Respecting the values of both positivist and constructivist research, I employed the multi-paradigmatic design space by interacting with 'self' and 'others' to realise the multiple realities. It was really challenging to involve myself in identifying and transforming socially unjust structures, beliefs and practices.

To carry out the research study, I employed auto/ethnography as research methodology and writing narrative as a method of inquiry. As an auto/ethnographer, I could excavate my lived and living pedagogical experiences and contradictions and deeply involve myself into the realm of research participants so as to excavate their 'real' stories. It was amazing using narrative inquiry to unearth and portray such told and untold stories of mine and the people involved with my professional life-world that they including me were unaware.

To enrich my multi-paradigmatic research inquiry into the problems of pedagogical practices faced by teachers and students, I employed multiple research logics and genres such as hypothetico-deductive, dialectical, metaphorical, poetic, and narrative. These research logics and genres helped me represent narratives in multiple ways such as story writing, poems, metaphors, pictures, etc. It was astounding to employ multiple research logics and genres because they helped me excavate and express all sorts of narratives that were told-untold, conceivable-ineffable, pleasant-unpleasant, etc. in such a successful manner that I could make sense and meaning of what I did throughout the research study.

I employed the quality standards according to three paradigms – transferability of interpretivism, pedagogical thoughtfulness and critical reflexivity of criticalism, and illuminating and verisimilitude of criticalism so as to regulate the quality of my research. Finally, I employed four ethical standards (ethic of care, ethic of civic transformation, ethic of responsibility, and ethic of compassion)so as to preserve the rights, values, needs, and desires of human beings associated with the research study.

Most importantly, it was a tough gulp for me to read others' hearts and minds and to make others able to read my heart and mind. For this, on the one hand, I had to act as a friend, as a parent, as a teacher, as a brother, as an artist such as a singer, a dancer, a comedian, etc. to make them able to read my heart and mind. More so, I had to visit and revisit the research participants many times so as to read their hearts and minds by using various means such as formal/informal conversations, informal interviews, human networks such as parents, college teachers, students, the Principal and Managing Director of the school, etc., and social networks such as Facebook, Twitter, mail, etc.

Despite many challenges, multi-paradigmatic research design space opened my heart and mind while excavating and expressing affable stories via usual way of writing, and ineffable stories via different research logics and genres. It was really a different but cheerful experience to employ poems, metaphors, analogies, adages, idioms, phrases, pictures, etc. so as to capture all possible stories while writing narratives. Moreover, multi-paradigmatic research design helped me look at bigger picture of the nature of knowing in my research inquiry. I could consider my life experiences as primary sources of evidence, which was really a matter of valuing 'self' in my research inquiry because I could find 'otherselves' in my 'self'. I could value 'others' because I could enter 'otherselves' and find my 'self' in 'otherselves'.

CHAPTER III

REDUCTIONISM IN MATHEMATICS EDUCATION: PROMOTING LINEARITY IN TEACHING AND LEARNING

In general, reductionism in mathematics education has been conceived as a tendency to reduce whole into parts, thereby studying them in isolation via the assumption that parts represent the whole. Subscribing to the notions of reductionism stated by Luitel (2009, 2017), I have viewed reductionism in mathematics education from four perspectives: *reductionism as ideology, reductionism as methodology, reductionism as logic,* and *reductionism as/through history.*

In the context of Nepali mathematics education, *reductionism as ideology* cultivates a mechanistic view of mathematics education that all visions, views and perspectives are necessarily reduced to some fixed technical procedures, and is translated into an extreme form of victim-blaming ideology that ignores political, social and systemic weaknesses, thereby holding individuals situated at receiving end of the education system entirely accountable for their failure. Therefore, reductionism as ideology in mathematics education draws on Euclidian model of thinking that reduces all possible mental and visual imagination to a plain geometry – a geometry of zero curvature.

Reductionism as methodology arises from the assumption that parts have ontological and epistemological primacy over wholes (Rose, 2003). I feel that reductionism as methodology embedded in Nepali mathematics education portrays the process of curriculum development as prescribing a list of subject matter and teaching methods.

Reductionism as logic seems to privilege an exclusively linear-causal model facilitated by propositional, deductive and analytical logics that account for a few factors of a system by allocating excessive explanatory weight to them. Propositional logic is about making a declarative language that can be depicted either yes or no whereas deductive logic is about using ethereal law-like statements to map down particulars. The idea of analytical logic puts emphasis on setting up a definite divisionary line, thereby selecting one out of many categorical options.

Reductionism as/through history acknowledges how reductionism began to shape European education so as to prepare citizens with discrete skills and knowledge required for industrial society in the passage of time based on the history of Western philosophy from the early Greek thinkers to till date, thereby giving rise to modern mathematics, and this notion of reductionism is gradually transported to their colonies around the world. Through the historical sketch, it seems that mathematical ideas are reduced to symbols and signs as main features of modern mathematics, giving over-emphasis on semiotics – "any sign action or sign process: in general, the activity of sign" (Colapietro, 1993, p. 178). Presmeg, et. al (2016) also highlighted that "the significance of semiosis for mathematics education lies in the use of signs; this use is ubiquitous in every branch of mathematics" (p. 1). My concern here is not to ignore such notion of reductionism; based on my experiences, however, I am anxious about the hegemonic nature of semiosis due to reductionism in Nepali mathematics education that has been subordinating and/or neglecting local knowledge to be incorporated in the mainstream of mathematics education in the name of so-called globalization.

Serving as a mathematics teacher and educator in the field of Nepali mathematics education for more than two decades, I have encountered with all of the above notions of reductionism as ideology, as methodology, as logic and as /through history. In due course, I came to realise that such reductionism has reduced Nepali mathematics education into culturally decontextualised mathematics curriculum, disengaged pedagogy and standardized assessment (sit-for-test) system. In this regard, subscribing to my research agenda, I conducted my inquiry into prolonged problems of pedagogical practices due to reductionism in Nepali mathematics education.

Regarding the reductionist pedagogy, not only in Nepal, mathematics pedagogy is also gaining an increasingly reductionist flavour in UK schools (Foster, 2013) and probably all over the world. Moreover, mathematics teachers are seen giving an excessive focus on bite-sized learning objectives ad a tendency for mathematics teachers to path-smooth their students' learning. In this regard, as a conventional reductionist mathematics teacher, in this chapter, I have addressed my first research question: *As a conventional teacher, in what ways did disempowering features of reductionism persuade me to promote linearity of teaching and learning of mathematics?* I have presented six narratives: *Pedagogy as/for Sacred Knowledge Transmitter, Pedagogy as/for Finished Product Practitioner, Pedagogy as/for Target Hitter, Pedagogy as/for Bigger Sight Loser, Pedagogy as/for Microscopic Teaching Conniver,* and *Pedagogy as/for Emergent Phenomena Resister*, followed by Recapitulating the Chapter and Key Message of the Chapter. All the narratives are based on my journey of teaching Mathematics.

The chapter articulates how different disempowering features of reductionism in mathematics education gradually provoked me to develop reductionist mathematics pedagogy, thereby ultimately persuading me to promote linearity in teaching and learning of mathematics. Before that, let me present a poem that depicts my story about how I as a linear mathematics teacher became thoughtful about the emergent behaviour of nonlinear teaching and learning of mathematics.

Thoughtful About Emergent Behaviours of Pond Water

As a linear mathematics teacher, I often had linear concerns.
I often reduced mathematics into tiny knowledge and skills.
I tried to help my students learn particular skills or information.
I tried to help my students shape their thinking and acting.
I trained my students in learning a variety of techniques
To organize what comes first and second in order, and
To assess if my students learned what I taught.
I was happy being a linear mathematics teacher
But one day – I was sitting on the brim of a pond,
Expecting a summer shower,
Throwing pebbles into the pond water,
Observing the ripples of water waves going in all directions!
Suddenly, the sky got black-clouded,
I saw rain-drops coming down!
Sprinkling at first and intercepting those ripples,
Each drop created its own new circular life-world,
Instantly, when the rain came down harder,
I observed rain-drops dancing!
When the rain stopped, I could observe only the pond water,
As the rain water was vanished into the pond water!
And I got worried about my linear concerns,
Then became thoughtful about emergent behaviours of the pond water!

Pedagogy as/for Sacred Knowledge Transmitter

"How many of you have learnt the multiplication table up to 15?"

"Did you learn the steps of multiplication and division?"

"Without knowing the steps, you can't do and learn mathematics."

Beginning the very first class in Grade VI, this is how I started my journey of teaching mathematics from Grade VI to IX when I professionally became a school mathematics teacher in 1993. Being a BSc graduate, I had never taken any formal course of mathematics education rather I had got some experiences of teaching mathematics in private tuitions and coaching classes before I came to Kathmandu valley for my master's degree. I always tried my best to transmit to my students the sacred knowledge and skills I had accumulated from my mathematical ancestors (e.g. teachers). I always engaged my students in task-oriented problem solving – how to do something or how to perform (Mezirow, 1990). It means that I was transmitting instrumental knowledge through task-oriented problem solving to transmit instrumental knowledge (Habermas, 1972; Grundy, 1987; Cranton, 2002). Moreover, instrumental learning involves the process of learning to gain the objective knowledge by controlling and manipulating the environment.

Therefore, I realise now that my "egocentric self" always persuaded me to train my students as I was trained by my mathematical ancestors (e.g. teachers) and would enforce them to follow the mechanistic steps that I provided them before doing mathematics problems. My coercive enhancement towards learning often helped students achieve better marks than ever, which made me famous "IM Sir" among the students. Let me portray a narrative regarding standard algorithm of multiplication:

It could be July 1994. I was teaching Arithmetic in grade 5. To multiply 4607 by 89, I followed the following procedures (steps) of standard algorithm.

$$
\begin{array}{r}
4\,0\,5\\
\cancel{5}\,\cancel{0}\,\cancel{6}\\
4\,\cancel{6}\,\cancel{0}\,7\\
\times\;8\,9\\
\hline
4\,1\,4\,6\,3\\
+3\,6\,8\,5\,6\,\times\\
\hline
4\,1\,0\,0\,2\,3
\end{array}
$$

First, multiply the number 4607 by the unit digit 9 starting from 7 and moving towards left. Multiply 7 by 9 giving 63. Write 3 below the 9 under the line and 6 as carry-over at the top of the 0. Next, multiply 0 of the number by 9 giving 0. Add the 0 to the carry-over 6 and write their sum 6 to the left of 3 below the line. As there is no carry-over, write 0 to the left of 6 at the top of the digit 6 of the number. Now multiply 6 by 9 giving 54. Add 54 to the carry-over 0 giving 54. Write 5 at the top of 4 just left to 0. Finally, multiply 4 by 9 giving 36. Add it to 5 giving 41, which is written just to the left of 4 below the line. Now it's the turn of ten's digit 8. Before that, mark cross (×) just below 3. Multiply 7 by 8 giving 56. Write 6 below the 6 of the product 41463 and write 5 as carry-over at the top of 6 of the previous carry-over 6. Multiply 0 by 8 giving 0. Add it to the carry-over 5 giving the sum 5 which you write to the left of the 6 just below 4 of the previous product 41463. As there is no carry-over, write 0 as carry-over to the left of the 5. Multiply 6 by 8 giving 48. Add it to the carry-over 0 giving the sum 46. Write 6 to the left of the 5 below 1 of the previous product 41463 and write 4 as carry-over to the left of 0 at the top of 5 of the previous carry-over 506. Finally multiply 4 by 8 giving 32 which you add to the carry-over 4 giving the sum 36. Write it to the left of the 8 finally giving the number 36856. Now, add the two products 41463 and 36856 to get the sum 410023, which is the product of the numbers 4607 and 89.

This is an example of how I followed the footsteps of my mathematical ancestors in a sequential order to train my students in the standard algorithms of multiplication. Moreover, I was using deductive reasoning to teach mathematics which was most prevalent at that time in Nepal. In this regard, I confess that my pedagogy mostly gave priority to deductive reasoning which helped my students learn the process of using general rules and principles to come to conclusions about specific information or situations (Marzano & Pickering, 1997, p. 146). I would explain very vividly by solving several problems and coercing students to do the similar problems many times, provided that all the students had already known the multiplication table very well. I think this was my first formal encounter with reductionism in mathematics pedagogy. Foster (2013) asserts that "In a reductionist pedagogical paradigm, the subject is broken down into numerous tiny skills and pieces of knowledge, which are then taught separately and sequentially (p. 564)." Of course! I reduced my pedagogy to the tiny skills to simplify the complex idea of multiplication, which has been working till date. Knowingly and/or unknowingly, I often followed "the traditional triple-X lessons: explanation, examples, exercises" (Swain & Swan, 2007) in which the problem is broken down into various facts and skills.

It could be May 1994. When I taught Algebra in Grade VIII, I was much more confident in my instrument of reducing the complex mathematical ideas and entities into the simpler form so that students were easily trained like animals are trained in circus. While teaching factorization of algebraic expressions, I first gave all the algebraic formulae, and asked students to rote-learn them and come prepared in the grade. The very next day, I classified the different types of factorization as prescribed by the curriculum:

(i) Factorization of the expression having two terms

(ii) Factorization of the expression having three terms

(iii) Factorization of the expression having four terms

(iv) Factorization of the expression having five terms

I then explained the algorithmic skills and wrote the tiny steps on the blackboard so that all the students copy as it is:

(i) Factorization of the expression having two terms: First take common if possible. After that, check if any of the following formulae can be applied:

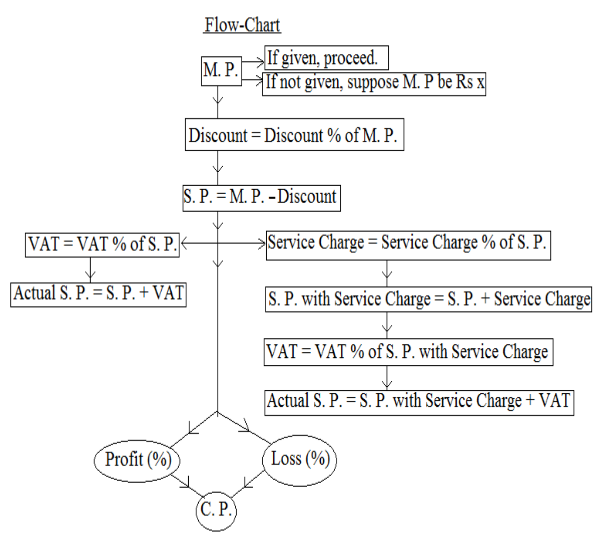
$a^2 - b^2 = (a + b)(a - b)$, $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$, $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$ and $a^2 + b^2 = (a + b)^2 - 2ab = (a - b)^2 + 2ab$.

(ii) Factorization of the expression having three terms: First, take common if possible, After that, use mid-term factorization method or the formulae $a^2 + b^2 = (a + b)^2 - 2ab$ or $(a - b)^2 + 2ab$. If the expression contains power 4, use the formulae of $a^2 + b^2$, otherwise use the method of mid-term factorization.

(iii) Factorization of the expression having four terms: Group the terms by 1 term and 3 terms, or 3 terms and 1 term. Use the formula of $(a + b)^2$ or $(a - b)^2$ in the three terms, and then use the formula of $a^2 - b^2$.

(iv) Factorization of the expression having five terms: Use the formula of $(a + b)^2$ or $(a - b)^2$ by splitting the first two terms into three terms in the form of $a^2 + 2ab + b^2$ or $a^2 - 2ab + b^2$. After that simplify the other remaining terms and convert them again in the same formula of $(a + b)^2$ or $(a - b)^2$ and finally use the formula of $a^2 - b^2$.

It could be June, 2017. While teaching profit and loss in grade X, I still follow the same linear way of teaching and learning of mathematics. While teaching the problems of profit and loss, marked price and discount, service charge and VAT,



I draw a flow-chart and explain it with the help of examples. I have found my students improving mathematics very well using flow-chart. In this way, I have been using linear method of teaching mathematics in the classroom which has been helping my students solve the problems easily by using certain rules and algorithms, no matter whether they learn meaningfully or not.

Moreover, the standard algorithmic problem-solving method became my one and only crucial pedagogical skill which helped my students improve their mathematical skills and achieve better marks in the examinations. Regarding algorithm, Ferreira (2010) stated that an algorithm is a well-defined procedure, consisting of a number of instructions that are executed in turn, in order to solve the given problem (p. 14). It suggests that I was undoubtedly using algorithmic problem-solving method in which the solution consists of a sequence of instructions. On those days, students' performances in the examinations would determine the quality of teachers, and I deserved it when my students improved their marks in the examinations, especially in the SLC examinations. I think I got used to with "a crude behaviourism that equates knowing with a performance and stressing the crucial nature of underpinning knowledge" (Tarrant, 2000, p. 78).

Above all, I developed my culture of teaching mathematics using pedagogy as/for sacred knowledge and skills transmitter, giving rise to the culture of linearity in my pedagogy. Here, I confess that I didn't learn it from any educational trainings and workshops, rather I got it from my mathematical ancestors as/for sacred knowledge and have been transmitting it to my students in the form of instrumental knowledge by diminishing mathematics to a minimal set of procedural skills to be mastered sequentially (Habermas, 1972).

Pedagogy as/for Finished Product Practitioner

"Sir, I first read the theorem you taught us yesterday and practiced it only three times. I am now perfect in proving this theorem."

"Sir, I have practiced this theorem ten times at home! So, I can prove it easily."

"Sir, I practiced it many times, but it did not get into my head."

"Sir, theorems are very tough to memorize."

"What is the advantage of proving theorems, Sir?"

"Sir, why not geometric theorems are omitted from the textbook!"

These voices of my students still echo my ear when I would encourage my students to learn theorems. In my experience, I have found that most of the students fall short of geometrical knowledge and skills, and hence they lack interest in learning geometry. I have rarely found students enjoying geometry learning. In the beginning of teaching geometry theorems, which I would like to call as finished products, I would try my best to give very basic axioms and postulates necessary to prove theorems.

More precisely, I would say, I would break down the whole theorem into tiny knowledge and skills, link them to axioms and postulates, and prove the theorem in a sequential order, like "to understand the Descartes' clockwork machine, it should be dismantle and examine the individual components" (Baker & Morris, 2002), which is the pure modern scientific reductionism (Wilson, 1999). Using such mechanistic reductionism in my pedagogical practices, I was gradually provoking my students to follow the procedural skills in learning the "Already" proved theorems; I am not sure now why I followed such instrumental scientific approach of teaching; but I feel now that it was the only known method that helped my students learn "how to prove theorems". I still remember those days in 1993/94 when I taught theorem to my students of Grade VIII.

First, I wrote the theorem on the blackboard:

Theorem 1: If a straight-line meets another straight-line, the sum of the two adjacent angles so formed is equal to two right angles.

Before proving this theorem, at first, I explained it by drawing a figure. While so doing, I dismantled the theorem into different parts.

(i) There are two straight lines, one of them meet another.

(ii) A straight line forms a straight angle measuring two right angles.

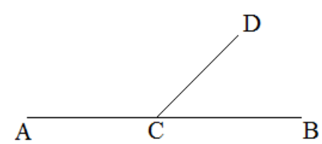
(iii) "Sum of the parts is equal to the whole" called as "Whole-parts axiom"

(iv) If two different unknown quantities are equal to the same quantity, they are also equal. For example, if $x = z$ and $y = z$, then $x = y$.

After explaining these axioms and postulates, I began to prove theorem.

Given: The straight line DC meets another straight line AB at C and makes the adjacent angles ACD and BCD.

To prove: $\angle$ACD + $\angle$BCD = 2 right angles



Proof:

	Statements		Reasons
1.	$\angle$ACD + $\angle$BCD = $\angle$ACB	1.	Whole-parts axiom
2.	$\angle$ACB = Straight angle	2.	ACB is a straight line
3.	$\angle$ACD + $\angle$BCD = Straight angle	3.	From Statements (1) and (2), by using equality axiom
4.	$\angle$ACD + $\angle$BCD = 2 right angles	4.	A straight angle = 2 right angles

Conclusion: Therefore, it is theoretical proved that if a straight line meets another straight line, the sum of the two adjacent angles so formed is equal to two right angles.

As mentioned in the narratives earlier, I asked my students to learn this theorem at home. I coerced them to practice it many times until they know. The following day in the classroom, I asked them if they learned theorem. It was fifty-fifty in the classroom. I again revised it and then asked them to practice sufficiently in the classroom.

This is how I started my journey of teaching Geometry formally in the school. Further, in the same year in Grade IX, I had to teach theorems related to congruent triangles. Before I started proving theorem, I said to the students, "Do you know about congruent triangles and five tests of congruency of triangles?" Most of them requested me to revise it from the basic and teach them to prove theorems related to tests of congruency.

I wrote five tests of congruency of triangles:

(i) S. A. S. (Side, Angle, Side) Test

(ii) S. S. S. (Side, Side, Side) Test

(iii) A. S. A. (Angle, Side, Angle) Test

(iv) R. H. S. (Right angle, Hypotenuse, Side) Test

(v) A. A. S. (Angle, Angle, Side) Test

I explained each of them one by one clearly and gave two "mantras" for proving theorems of congruent triangles:

(i) If you are asked to prove that two sides or two angles are equal, use the test of congruency.

(ii) If two triangles are not given, construct so as to form two triangles and use the test of congruency.

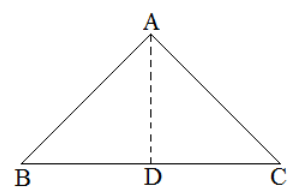
After writing the statement of the theorem on the blackboard "The base angles of isosceles triangle are equal", I began to prove it by explaining stepwise.

My explanation: *Based on the statement of theorem, you need to draw correct figure and label it.* (I draw a figure accordingly)

My Explanation: *After drawing the figure, write the given things on the basis of labeled figure.*

Given: In isosceles Δ ABC, AB = AC, and $\angle$ABC and $\angle$ACB are the base angles.

My Explanation: *The next step is to write "To prove", that is, what is to be proved should be written on the basis of the labeled figure.*



To prove: $\angle$ABC = $\angle$ACB

My Explanation: *"What to prove here?" I asked a question to the students. "Two angles are equal." They replied immediately. "Good! Then, how do you do it?" I asked them and waited for a while. No one spoke up. I began to explain. "As I told you earlier that two prove that two angles are equal, we have to apply test of congruency." Next, I said to them, "What step should we do next?" The first girl stood and said, "We need two triangles and hence construct two triangles." (It was amazing that brilliant students catch things when teacher helps them. I rolled my eyes to the others who looked helpless.) "Very good! So, how to construct two triangles! … There are two options: one, draw a perpendicular AD from the vertex A to the base BC so that two triangles seem to be exactly equal or draw a bisector of the vertical angle BAC meeting the base BC at D. Here, I prefer the second option." After this, I drew the bisector and wrote it in "construction".*

Construction: From A, the bisector AD of $\angle$BAC is drawn meeting BC at D.

<u>My Explanation</u>: *"The next step is the "proof" part. Which axiom of congruency is applied? Can you tell?" I asked them and waited for a while. They tried but could not tell me the correct answer. I said, "On the basis of 'Given' and 'Construction', we had to check which one of the five axioms of congruency will be applied. You cannot claim that you will apply the axiom of your choice. Now check which test can be applied." I began to explain which parts of two triangles are equal. Finally, they were able to find the correct axiom. "Very good! It's S. A. S. test … Further tell me what would happen if two triangles are congruent?" One boy stood up and said, "Their corresponding sides and angles are equal." I said, "Exactly! You are correct." (I kept on filling the Proof table during explanation, and the proof table is given below.)*

Proof:

	Statements		Reasons
1.	In Δ ABD and Δ ACD	1.	
(i)	AB = AC (S)	(i)	Given
(ii)	$\angle$BAD = $\angle$CAD (A)	(ii)	AD bisect $\angle$BAC, by construction
(iii)	AD = AD (S)	(iii)	Common side
2.	Δ ABD $\cong$ Δ ACD	2.	S. A. S. test of congruency from Statement 1
3.	$\angle$ABD = $\angle$ACD i.e. $\angle$ABC = $\angle$ACB	3.	Being corresponding angles of congruent triangles

Conclusion: Therefore, it is theoretically proved that the base angles of isosceles triangle are equal.

This is how I would teach geometrical theorems so that my students could get into the matters and show their interest in geometry. NCTM (2000) recommends that "the mathematics education should enable students to recognize reasoning and proof as fundamental aspects of mathematics, make and investigate mathematical conjectures, develop and evaluate mathematical arguments and proofs, and select and use various types of reasoning and methods of proof" (p. 56). It states that geometry plays a vital role in developing an ability of logical reasoning in students. However, what I mostly found during examinations always ridiculed me as most of the students rarely solved the geometric problems. They lacked geometrical reasoning and proof. I was so proud of myself in explaining things stepwise to my students realizing that everyone had understood how to prove theorems. Nonetheless, I feel now that I was totally in false consciousness and realise that I was revealing the being part of geometric theorems using reductionist pedagogical approach as such Raman (2005) asserts that "reductionism reveals the being part of the world, but not always the becoming part" (p. 251).

I come to realise now that I was not able to catch the becoming part of geometric theorem or more precisely, meaning that I was unable to see what my students would learn practically after providing them with such procedural skills of solving geometry theorems. However, my effort of reinforcement in learning geometric theorems by using reductionist pedagogical approach gradually persuaded my students to follow linear path of learning resulting to their improvement in scoring better marks in Geometry. No matter what they would become, I would always measure their knowledge and skills via 'sit-for-test' (Luitel, 2003) assessment system. Basically, I come to realise now that I was just transmitting to my students the procedural skills and instrumental knowledge via reductionist pedagogy as/for finished product practitioner. Sometimes, I would feel why I was teaching geometry theorems which our ancestors had already proved. Why? However, I had no culture of thinking critically and never allow students to think critically.

Pedagogy as/for Target Hitter

"I have observed your talent in teaching mathematics, Sir. All the students are also very happy to have you in our school. You know very well that our school is upgraded to grade X this year and our students are going to appear in the SLC examinations, the 'Iron Gate' for the first time. It is your duty and responsibility to set a target and help us achieve the best result in the SLC … I have increased your salary to …. And it is a bigger sum compared to other subject teachers." It could be any day in April 1994 just before the new academic session began when the Principal of the school called me in his office and served his sermon of interests analysing my duty and responsibility with some praiseworthy words and increment in salary. As mentioned earlier, I started my journey of professional teaching a year ago from the same school in Kathmandu valley, and the school was being upgraded. That year, all the students of Grade IX were promoted to Grade X ,and I had more duty and responsibility than other teachers as in almost all schools in Nepal there was a mind-set that Mathematics was a good scoring subject, thereby helping students increase their percentage. Most interesting aspect of salary was that Mathematics teachers were paid better than other subject teachers, because of which Mathematics teachers were like a pressure cooker filled with duties and responsibilities of training students to better score in examinations.

"Thank you very much, Sir! No worries, I make a tentative plan and set a target. Let's see how it goes!" This was my informal promise to the Principal. I came out of the office thoughtful, "Oh, I have to set a target!" I remember there was no any practice of making any lesson plan during those days. I had no any idea about the plan, but I had plans in my head. I was much confident in delineating what "Everything was in my head!" to the classroom practices and much more certain

about the denouement of the drama constructed in my head: I was pretty confident in training my students so as to give the best outcome to the school.

The first day began with one-way traffic of teaching: I spent almost half of the period to make them realise their duties and responsibilities. “Don’t be irregular in the school … You may remain absent if you will have a serious health problem, provided that you will show the proofs such as a prior application, phone calls, doctor’s medical prescriptions, etc. You must do home-works regularly … Always memorize the formulae … You must practice mathematics many times at home until you can do it … Don’t gossip in the classroom as I don’t entertain students’ side-talks … Just listen to me while I am teaching in the classroom … Most importantly, all of you must get at least fifty percent of marks in all the unit tests or exams … Otherwise, you know my temperament…”

<u>Basic Algebraic Formulae</u>

$$(a + b)^2 = a^2 + 2ab + b^2$$
$$(a - b)^2 = a^2 - 2ab + b^2$$
$$(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$$
$$= a^3 + b^3 + 3ab\,(a + b)$$
$$(a - b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$$
$$= a^3 - b^3 - 3ab\,(a - b)$$
$$a^3 + b^3 = (a + b)\,(a^2 - ab + b^2)$$
$$= (a + b)^3 - 3ab\,(a + b)$$
$$a^3 - b^3 = (a - b)\,(a^2 + ab + b^2)$$
$$= (a - b)^3 + 3ab\,(a - b)$$
$$a^2 + b^2 = (a + b)^2 - 2ab$$
$$= (a - b)^2 + 2ab$$
$$a^2 - b^2 = (a + b)\,(a - b)$$

After feeding ‘dos and don’ts’, I wrote basic Algebraic formulae on the blackboard and asked them to copy and start their journey of Grade X Mathematics from rote-memorization.“This is your home-work … Memorize all the formulae and come tomorrow. I will ask you one by one.” The class was over.

The very next day, I began my class by asking the formulae. Their bad luck! Two students, one boy and a girl, could not tell all the formulae! I treated them with some slaps, pulled the temple of the boy and the hair plates of the girl and poured some filthy words on them. I could observe pin-drop silence in the classroom. For revision, I wrote some questions of factorization on the blackboard and asked everyone to solve. There could be about 15/16 students (I am sure about the number which did not exceed 20. I tried my best to contact the concerned person of the school so as to find the exact number of students but it was not possible as the school was sold to another party.), and some students could not solve some questions. I began to teach the factorization from the very basic level and continued my classes in the similar way.

After completing each topic, I began to give the tests of 25 marks with pass marks 12.5. If anyone failed to achieve pass marks, I would punish them physically, ask them to learn it again, and take the test again in the very next day after school. I still remember those diverse students, some of which were brilliant, some medium and some very low achievers in Mathematics. Out of the low achievers, there was a student who had some mental problem and was taking medicine. He never scored pass marks in any tests and exams. One day, the Principal called a Mathematics expert; there was a rumor that he was a textbook writer and also one of the SLC questions makers. The Principal took the help of him to check the student's mathematical ability. He taught how to construct a triangle if the sum of its all sides and two angles are given. After explaining the steps and drawing the triangle, he asked the student to tell the steps of construction. His bad luck; he could not tell at all! The expert again explained the steps and asked the students to tell once again. He again could not tell. "This boy cannot pass Mathematics in his whole life …" The expert uttered his words as if he was the messenger of 'Saraswoti', the goddess of knowledge and went away with the Principal.

The student began to cry. His sobbing in my ears and tears on his eyes made me emotional. I held him within my arms and consoled, "Hold on, hold on, boy! I am here to help you. I promise you that I will help you get at least pass marks in the SLC examination. Don't worry. But you should also promise me that you will follow my instructions and do home-works regularly." Since then, this boy became my concern. As soon as the expert left the school, the Principal called me in his office. "Sir, can we help that boy?", said the Principal. I immediately said, "Yes, Sir! I can do for him. The pass marks is 32 and I will target 40 for him and guide him accordingly." The Principal was thoughtful for a while and said, "I would be happy if you could. More than that, his parents in Japan would be happier." I knew that his parents were in Japan. I heard that since the time his parents left him and his younger brother in the hostel during when he was in Grade 4 and his brother in Grade 3, he often cried for his mother just before going to bed and the hostel maid (who was also one of the shareholders of the school) would treat him so brutally that he gradually became a tough guy and lost his mental state. As a result, he gradually declined from study and failed in Grade 7 and became the classmate of his own younger brother since then. He was given a mental treatment when he was in Grade 8 and was taking medicines since then, about which he told me when I interacted with him.

Knowing all his case history, I began to show my affection towards him and treated very friendly with encouragement time and again. Nevertheless, I would threaten him too by reminding him the event happened with the expert. I think I was knowingly/unknowingly dealing him with his cognitive and as well as affective domain. More precisely, I was indirectly training him with emotional blackmailing. Gradually, he became a slave of my culture of discrete tasks and instructions and followed my footsteps setting the target of 40 marks. I gave him the selective topics that covered about 60 marks in the SLC exam and asked him to just keep on practicing the problems from the same topics. Bravo! He scored 46 marks in the SLC, while the first boy of the class scored 98 in Compulsory Mathematics and 94 in Optional Mathematics. The Principal was very happy with the SLC result, which became a key reference for me to become a popular mathematics teacher in the school as a 'pundit' of mathematics.

It could be any day of April 2005 when I was a new teacher in a reputed private boarding school in Kathmandu valley. It was like a paradigm shift for me in changing the school. For the first time, I was teaching mathematics on whiteboard with marker pens in the well-furnished classroom bearing carpet on the floor: new experience of replacing blackboard, chalks and bare cemented floor, and getting rid of dusts! Ah! Putting off the shoes outside of the classroom and the bitter smell of socks and shoes of the students were some amazing experiences as well. For the first time, I came to know about lesson plan in this school, albeit I have heard it elsewhere, which was too much absurd for me in the beginning. Nevertheless, a new avenue of my teaching career has started in the new school with diverse students: Only one batch of students had passed out from the school and it was the second batch. When I started my class, I was much more surprised to find some students of low standard, not meeting the standard of Grade X and the remaining students were also not as my expectation. The background of school was that the school was founded by the renowned college owners, and hence I had an assumption that the school must have collected brilliant students, but I was totally in false consciousness.

As time went on, I found many students even had no any basic Arithmetic and Algebraic skills and concepts. A few had problems even in four basic operations (+, –, ×, ÷), simplification of fractions. I directly approached the Principal and explained the identified problems. He said, "That's why; we selected you, Sir! You being BSc graduate have won the battle among many candidates who have done master's degree. Even a teacher who was a distinction holder in his master's degree was rejected by our students. Now just think for a while why our students selected you. It's because of your long experience in teaching. I believed you and so did our students." I was speechless.

I came out of the Principal's office with heavy heart and mind. What I had thought, what it happened! The popular Nepali adage came into my mind, "*Chokta khaana gayeki budi, jhol maa dubera mari*"[5]. I could see only clouds and darkness in my new pedagogical voyage. I was hopeless and it was frustrating. I still remember the very night that I spent restless and sleepless. Those wakeful moments of that very night were shocking and appalling. I had a serious conversation with my better-half: I made up my mind to discontinue the school, but my better-half reminded me about the salary which was much more than the previous one. I think my family responsibility enforced me to continue my career in the same school where I continuously worked for ten years.

The following day, I again approached the Principal with some plan in my mind. I requested him for remedial classes in the morning.

During the remedial classes I first checked the level of the students taking a test. I found that most of them were below the level of Grade X.

When I individually asked the following questions, I was surprised to see their solutions: $2x - 3x = 1x$, $5x - 4x = 1x$, $-5x - 3x = 2x$, $(2x) \times (-3x) = -6x$, $(-2x) \times (-3x) = -6x^2$, $(-2x) \times (3x) = -6x$, etc. More so, they also had no idea of addition, subtraction, multiplication and division of fractions. For examples: $1+\frac{1}{2}$, $1-\frac{1}{2}$, $\frac{2}{3}+\frac{1}{2}$, $\frac{3}{4}-\frac{5}{6}$, $4\times\frac{5}{6}$, $\frac{6}{14}\times\frac{7}{8}$, $10\div\frac{5}{3}$, $\frac{8}{12}\div\frac{4}{9}$, etc.

How to start the lesson! It was an awkward moment. It was a challenge for me to uplift them to the level of Grade X. Oops! I merely put up my hands! Nevertheless,

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[5]Trans: Gone for good but happened bad.

I made some rough plans and began to teach them from the very basic level by linking it to the curriculum of Grade X. Gradually, they improved and were able to get marks up to 40 out of 100 while the pass marks was fixed as 50 in the whole school. I still remember some failed students holding my arms and pulling me aside to request me for giving pass marks. I made them pass, provided that they promised me that they would pass in the next exam. But they never got 50 (pass marks) in the school exams. However, amazingly all of them passed Mathematics in the SLC exam getting more than 32 marks.

I come to realise now that my whole career of teaching was based on beforehand plans, either in my head or in the plan book by specifying objectives and teaching/learning activities with a specific outcome as target. I was successful in hitting the target to some extent. However, I never realised that I was just "hitting the target but missing the point" (Foster, 2006) which might be because I was developing "the reductionist ideology which has been an obstacle to envisioning fully an inclusive and holistic mathematics education in Nepal" (Luitel, 2009). I was, to some extent, successful to act upon "a didactic contract stating that the more clearly the teacher indicates the behaviour sought, the easier it is for students to display that behaviour without generating it from understanding" (Mason, 2000, p. 97). It is because not all students were successful to achieve their targeted outcome in the examination albeit their improvement always played an important role to save my service in the school, and the highest scores (more than 90) in both Compulsory Mathematics and Optional Mathematics evaluated me as a brilliant mathematics teacher during my career of teaching.

I think, breaking down pedagogy into tiny skills was being guided by the ideology of the Schubert's (1986) curriculum as discrete tasks and concepts, and that of training students in particular subject matters was being guided by the Schubert's (1986) curriculum as subject matters. Whatsoever, I come to realise now that I have developed the ideology of linear teaching and learning throughout my career of teaching as a unique way of teaching and learning of mathematics. I never thought of how academic Mathematics could be linked to outside world, the everyday life-worlds of students. Many issues arise in my mind now: Did I ever allow students to discuss randomly on any issue of mathematics? Did I ever allow students to discuss on "*lila-like*" nature of mathematics, other than "*rita-like*" mathematics? Was it necessary to dismantle my pedagogy into different sequential discrete skills so as to make students learn easily? Was it sufficient for me (and the schools) to be happy with the outcomes so obtained after my discrete tasks and concepts of subject and being "pundit" in subject matters? That's why; I comprehend that my pedagogical practices hit the target but missed the point: the point which students should have been able to apply as well as acknowledge in their practical life-world.

Pedagogy as/for Bigger Sight Loser

"Dear students, today you are going to practice problems from 55 sets … For this, discuss each other and solve the problems. Keep in mind that it's only about three months before you appear in Secondary Education Examination". This is how I instructed my students to engage in solving problems from the practice book! In most of the schools in Nepal, there is a culture of engaging students from 6 am to 6 pm each day when they are in Grade X so as to prepare them for the upcoming school SEE/SLC[6] examinations.

One morning on February 2017 at around 7 a.m., I found a group of girls

[6] SLC stands for school leaving certificate and SEE stands for secondary education examination. After changing the assessment system into grading system a couple of years back, the board exam of Grade X was termed as SEE in Nepal.

reading a paper, chanting something and laughing. When asked, one of the girls showed me the paper, in which I found the letter of confession written to Maths by a girl, who would hate mathematics and hence had no any interest in learning mathematics. I have presented her confessional letter as it is upon her consent:

Dear Maths

Please grow up and solve your problems yourself. Am tired of solving it for you. I love ur flaws, mistakes, imperfections. But not your questions. I wish I had a timemachine so that I would kill that person who invented you …

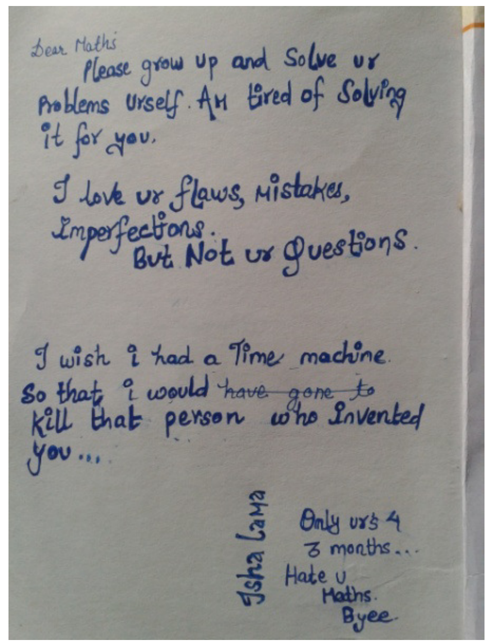
Isha Lama

Only urs 4

3 months …

Hate U Maths

Byee



Dear Maths
Please grow up and Solve ur Problems Urself. AM tired of Solving it for you.
I love ur flaws, Mistakes, Imperfections.
But Not ur Questions.
I wish i had a Time machine So that i would ~~have gone to~~ Kill that person who Invented you...
Isha Lama
Only urs 4
3 months...
Hate u Maths.
Byee.

Oh! Was it a good slap on my face by the student! I just kept on smiling at her (or myself) and asked her consent of using it in my research inquiry. Why? Why she hates Mathematics? I just inquired her informally many times. She repeatedly said, "I hate Mathematics, because I hate calculations which have no any importance in my aim of life." I said, "What is your aim?" She said, "Umm … ha … leave it, Sir!" I did not enforce her any more. Next time, I approached her close friends and asked why she would dislike Math. One of them said, "I also hate Mathematics, Sir. Umm … her aim is to become a good singer. But …" I said, "What but?" She was cool for some time and said, "But her father does not allow her for singing as her career." I immediately asked her why she also didn't like Math. "I hate Math because I have an interest in studying literature or law." I said, "That's fine." She continued. "You know, Sir. After SEE, I will squeeze, tear and throw all Mathematics books and exercise books into dustbin."

Though her friend told me why she (Isha) disliked Mathematics, I wanted to hear from her mouth. For this, I approached her many times informally and told her the importance of Mathematics in practical life-worlds. She accepted it but didn't unfold her secret. One day, there was an event of "Parents' Day" in the school. I saw her singing a good Nepali number and an English number. Later on, after she appeared in the Secondary Education Examination (SEE), she left the school. I had Facebook as a medium of communication with all the students. One night, I found her online and began to chat with her. I raised the same issue of why she hates mathematics. She said, "I dislike it because as much I do it, so much I get confused. Umm … doing maths from morning to evening is just killing my time, Sir! I cannot see any advantage of doing maths in my aim of life." I got her all the way. Yes, she must be frustrated from doing Mathematics two periods each day and engaging her for 12 hours in the school from 6 am to 6 pm. I think it was killing her creativity.

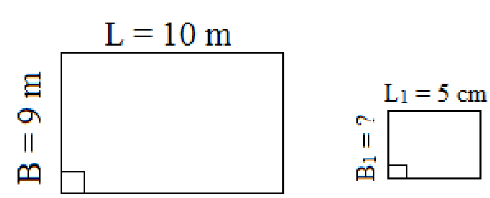
Likewise, my son Apurva is also in Grade X now and is repeating the same history of spending 12 hours from 6 am to 6 pm in the same school where I am a Mathematics teacher. After school he usually arrives home in between 6:30 pm to 7 pm., takes a light supper, turns on his mobile and holds his guitar. His supper and guitar both go side by side together. After spending half an hour, he begins to do his home-works. We take dinner in between 8:30 pm and 9 pm. He then continues his study till 11 pm and goes to the bed as he has to wake up early in the morning in between 5 am and 5:30 am to attend the morning class at 6:15 am in the school. I always take him with me by the motorbike and his routine-classes begin with Mathematics class.

Regarding my son, I have been observing his performances in a daily basis in two aspects: first, his performance in the exam, and second, his memory ability. On the one hand, miraculously, he grabbed the first position in the first term exam while he decreased his percentage by about 1 % and the previous first girl went down to third position while third boy grabbed the second position. But he would grab second position from Grade IX to X with 91. 4 %. More so, recently a memory test was conducted by the school, in which he could remember only 36 out of 50 objects while he could remember 46 out of 50 to grab first position when he was in Grade IX. He had also grabbed the first position when he was Grade VIII. “What happened to you, my boy?” I asked him. He said, “I left it … I didn’t care about it as I have to focus on study … I give less importance to such events.” I said, “You should have taken it seriously, my boy! … Anyway, it’s fine! … Don’t take it by heart … Just study normally without feeling pressure.” Most importantly, in the memory test a boy from the same Grade X who never scored better marks in the exams (usually gets 50 to 60 out of 100) grabbed the first position and is very active in the classroom interacting to the teacher and his mates as well.

Is my son losing the bigger sight of Mathematics? Are my students unable to conceive the beauty of Mathematics? I am speechless but have become thoughtful about why Mathematics is distracting my students’ attention towards learning its aesthetics. Are my students derailed from affective domain? What sorts of beliefs, values, attitudes and emotions towards Mathematics they are developing in them? What about me as a conventional teacher or transformative teacher? Am I still a conventional teacher following the smooth-path of teaching or am I a transformative teacher following the nonlinear path of teaching? What could be the reasons behind these issues? From above narratives, I realise that both teacher and students are on a huge pressure of completing the reduced tasks so as to show their performances based on standardized assessment system (Luitel, 2012). Teachers carry out their teaching-learning activities based on the assumption "what you test is what you get, and how you test is how it gets taught" (Taleporos, 2005).

Is mathematics all about scoring higher percentage in the exams? Am I developing the culture in my students that mathematics is all about its abstractness, purity (Luitel, 2012), absoluteness (Ernest, 1994) and objectivity? In this regard, Maheux (2016) asserts that we are still generally inspired by what some authors call the mythological/romance of mathematics in which mathematics is represented as abstract and disembodied, objective and inherently structured; logical, provable and therefore certain and universal. Does everyday mathematics look like as it is practiced in schools? I remember one event of 2015 while teaching similar triangles in Grade IX. I asked a question, "A room is 10 m long and 9 m broad. If the length of its map is taken as 5 cm, what breadth should be taken in the map?" All the students just kept on staring on the whiteboard and waiting my response. I expected that they would link it to the concept of ratio and proportion, but in vain. Neither they could link it to the concept of similar figures nor did they link it to the ratio and proportion. After all I had to explain and solve the problem myself.

At first, I explained how two quantities increase or decrease with same ratio in proportion. After that, I linked it to the question by drawing figure.



My explanation: “Since the room and its map are similar to each other, their corresponding sides i.e. lengths and breadths are proportional. Now, can you write proportional equation?” I waited for a while, but they were still in confusion. Immediately, I explained how proportion would work in our daily practical life. “Suppose Apurva’s wage per day is Rs 150 while that of Atithi is Rs. 100. If their wages are increased with the same ratio and the wage of Apurva becomes Rs 300, then what would be Atithi’s wage?” Some of them immediately said, “It is Rs. 200”. I said, “How?” They replied, “Because Apurva’s salary is doubled.” “Exactly …! Now find the ratios and write the equation of the proportion.” I went to see what they did and found: some of them writing correctly while others were just dumbfound. I then began the explanation and wrote the proportion equation as $\frac{150}{300} = \frac{100}{200}$. I threw a question on them, “Now, can you write the equation for the problem?” I waited for a while and observed them person to person. Most of them could do it correctly but others were just motionless. Finally, I solved it as follows: I first wrote the proportion equation: $\frac{L}{L_1} = \frac{B}{B_1}$. After that, I discussed how two quantities are compared with the help of ratio. “First you have to change the quantities into same units as ratio is the comparison between the two quantities of same kind. Suppose, you have got 100 Nepali rupees while you friend 100 dollars. Can you claim that you have got the same as your friend?” All laughed and said, “No.” I continued. “That’s why; you should compare the same quantities to find out the ratio.” I then changed the quantities into same units: L = 10 m = 10 × 100 cm = 1000 cm; B = 9 m = 9 × 100 cm = 900 cm. Finally I solved the problem to find out the answer: $\frac{L}{L_1} = \frac{B}{B_1}$ or $\frac{1000}{5} = \frac{900}{B_1}$ or

$B_1 = \frac{5 \times 900}{1000} = 4.5\ cm$.

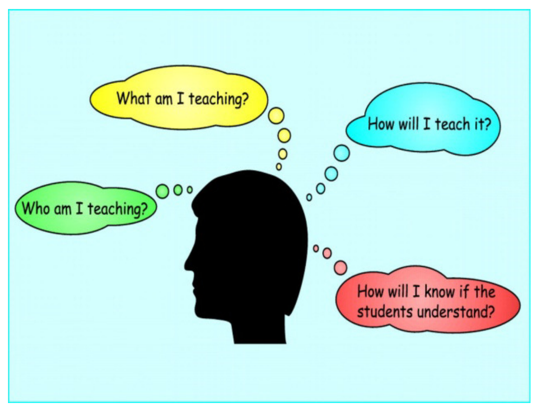
This is how my effort was spent teaching Geometry by linking it with Algebra and practical lifeworlds. On that day, I could just solve 3 more questions on the whiteboard. Why? Is it because of “the disempowering curriculum that enforces teachers to follow strictly disengaged pedagogy because the students have to be trained for appearing in the standardized assessment system?”(Luitel, 2009; Shrestha, 2011; Pant, 2015). My experience reflects that heavy contents of Mathematics curriculum always put pressure on teachers which results in engaging students the whole day in school, thereby killing their creativity, resisting their thinking process and producing mechanistic robots. Foster (2013) calls it as an audit culture in which teachers are constantly required, just in order to survive, to prove to their schools that they are “effective”. These show that students are given not much time to engage in meaningful learning process, instead they engage to fulfill the beforehand plans of teachers and focus on how to get higher marks in the examinations. Because of this, knowledge and skills are treated separately and hence there is no meaningful learning in the classroom. According to Skemp (1976), knowledge and skills must be seen as a unity, otherwise understanding is only instrumental. That’s why; I realise now why my students were so instrumental that they even could not think, imagine and link academic mathematics to their everyday mathematics albeit I often tried my best to show its bigger picture.

In this regard, I realised that mathematics is just reduced to the action of dismantling into tiny knowledge and skills and students have developed a culture of reading and practicing them so as to achieve the beforehand outcome. Tarrant (2000) argues that “the tendency to bifurcate knowledge of how to do something and knowledge that something is the case arises when too many examples of very basic practical skills are selected for analysis” (p. 79). I think that such culture of learning

Mathematics in the classroom probably lead students to limiting their learning within school boundary, and when they come out of the school after graduation, they become helpless as they (may) not be able to find any linkage between academic Mathematics and everyday mathematics: the bigger picture that resides in their practical life-worlds. Therefore; I think what I have been teaching as Mathematics to students was just influenced by the pedagogy as/for bigger sight loser.

Pedagogy as/for Microscopic Teaching Conniver

It could be any day in May 2005. Being a newly admitted teacher, I was adjusting myself in a new school. I had no any idea about teaching and learning lesson plans. The school ran three days' workshop on making plans. For the first time I got idea about how to make lesson plan. I came to know that the whole lesson (unit) is broken down into different components: Specific objectives, Teaching/learning materials, Teaching/learning Activities, Evaluation and Home-works. The Principal taught "how to micromanage the details of students' learning in the plan-book so as to make smooth-teaching" (Wigley, 1992, as cited in Foster, 2013, p. 573).



For the first time, I was learning to make the lesson plan. The Principal notified to all the teachers of the school not to enter the classroom without daily lesson plan. Moreover, every Sunday all the teachers had to stay back after school from 4 pm to 6 pm for making lesson plans, attending workshops and having wide discussion about how to teach effectively in the classroom. All the teachers were required to make their daily lesson plans and got them signed before leaving for home. I made and got them signed from the Principal. From the very next day, I began to implement my plans in the classroom. As time passed, day by day I found myself uncomfortable with my own teaching using lesson plan. Sometimes I could not meet the objectives while sometimes the assigned contents could not be completed within the specified time. The problems piled up and I partially failed to implement the plan in the classroom. Being a new teacher, I was afraid of sharing such problems with the Principal, thinking that all might have been successfully implementing their plans in the classroom. After a week, all of us from mathematics department sat together as the Principal had given the circulation that teachers should sit according to their department.

Once we began to share our experiences, every teacher confessed that they were also not able to implement the plans as effectively as they had expected. Most of them had the same problems as I had. Finally, the Principal concluded that those unfinished contents should be included in the next day's plan. The plan became humble-jumble, and teaching and learning process became directionless. However, after spending about a month, I could catch the rhythm of implementing the plan. For this, I learned how much contents should be included in a day and how to micromanage the students' learning smoothly. The plan guided my teaching and students' learning all the way. When the students have difficulties in doing problems, my plan helped me to assist them in solving stepwise. I think it is just all about mechanistic teaching and learning that I followed all the way as such Foster (2013, p. 573) also asserts that "when a teacher tries to help students understand some mathematics which they 'don't get', one often hears the teacher ask: Which step is it that you don't understand?"

The unit tests and term exams also showed the improvement in students' performances. Students were happy, parents were happy, the school was happy, and finally I was also happy with the way I was teaching Mathematics using micro-plans. Disintegrating pedagogy into tiny skills of solving mathematics problems was very much effective all the way. However, I have some issues in my mind: Was it the best pedagogical approach? Was I doing justice to my students' meaningful learning by imposing knowledge and skills from outside? Was learning in my control or students' control? Was I just reducing the complexity of mathematical tasks into manageable skills so that students have no need of thinking how and why such complexities were broken down? Nevertheless, I have experienced that "breaking down the mathematics problem is an effective technique for supporting students' mathematical learning" (Ainley, 1995). If it is so, was my reductionist pedagogy was supporting a meaningful learning of mathematics?

It could be February 2008 in the same school. It was the time when I was in the process of transforming myself as a constructivist teacher after I joined MEd in 2007, and it had been a year since I joined my master's study in Kathmandu University. I taught the topic "Mensuration" and asked students of grade IX to find out the area of floor and 4-walls of classroom, area of the basketball court and whiteboard and prepare a report.

I observed very intimately how they would measure different dimensions. I could saw one student holding the measuring tape at one end and other student on the other side. Remaining students were helping them to see the exact measurement in the tape. One group of students came to me and said, "Sir, which side of the tape is would measure the length?" "Oh, my goodness, any side you can use, dear! Check out, one side measures in feet and inches while the other side in metres and centimeters.” I explained as much as I could.

However, a student said, “But we have no any idea about feet and inches, Sir? We have not learned it.” They were right. The textbook dealt with the problems of having measurements in metres and centimeters those days (However, the revised curriculum has developed now the textbook containing the life-related problems to some extents.). It created doubt and hence when I visited all the groups, they had also the same problem. I called all the students back to the classroom and taught how to measure the length and breadth using measuring tape. Later on, they could accomplish their project and submitted the report the other day. It was very humiliating for me as a teacher that my students of Grade IX had no idea how to measure length, area, etc. practically though they knew it theoretically.

Now, I come to realise that such reductionist pedagogy always gave rise to linear teaching and learning of mathematics which always confined my students within the periphery of “dos and don’ts”. Nonetheless, since the time I completed my master’s project (Shrestha, 2011), I became an inquirer and began to find out how mathematics could be taught meaningfully in the classroom, and how mathematics could be culturally contextualised and linked to students’ everyday life-worlds. Shifting the conventional paradigm to constructivist paradigm was not a cup of tea for me. However, I gradually became aware of the fact that I had been often practicing reductionist pedagogy in teaching mathematics for a meaningful learning in the classroom. I also come to realise that I was leaving behind the non-linear aspects of teaching and learning of Mathematics in the classroom. In this regard, I began to practice how I could address students' both cognitive and affective domain (so as to produce a favorable environment while students are learning Mathematics in the classroom. For this I need to interact to students and encourage students to interact to each other and to the teacher as well.

In the meantime, I changed my teaching strategies, and one day which could be any day of 2010, after completing the topic "Equations involving surds and their solutions", I noticed that the values of variable (i.e. roots of the equation) vary from question to question. I also recalled why such values exist in surd equation. I knew that polynomial equations of degree n have n roosts but never noticed why surd equations, not being polynomial equations, contain more than one value. Let me give three examples:

First example: $\sqrt{x+6} = 5$ which gives one true value of x i.e. x = 19.

Second example: $\sqrt{3x+1} - \sqrt{x-1} = 2$ which gives two true values of x i.e. x = 1, 5.

The third example: $\sqrt{x+9} = x-3$. This also gives two values of x i.e. x = 0, 7. But only 7 is the true value while the 0 is wrong.

I told my students that such false values were called the extraneous roots of the equations. After that, immediately I gave a very simple problem to my students: "If x = 1, square it and find the values of x." They squared it and solved as follows:

Here, we have, x = 1.

Squaring on both sides, we get $x^2 = 1^2$ Or, $x^2 - 1^2 = 0$ Or, $(x + 1)(x - 1) = 0$

Either, $x + 1 = 0$ Or, $x - 1 = 0$

$\therefore$ $x = -1$ $\therefore$ $x = 1$

I asked the students to compare these two equations x = – 1 and x = 1 with the original equation x = 1 and they were puzzled.

They asked me why such happened and I said, “This is the beauty of mathematics!” Whether I was right or wrong, I had no any reason about the justification because I could not find anything about it in the textbook or in the curriculum. Now I realise that why I did not allow students to have a wide interaction in the classroom to find out why such values exist, and why I didn’t encourage them to investigate deeply. It suggests that I again followed the linear path of teaching and learning by solving the problems myself and making students realise the beauty of Mathematics. I think the schema once set in my mind was very difficult to transform (Mezirow, 1991). That’s why: I believe that time and again reductionist pedagogy persuades me to promote linear teaching and learning of mathematics. Moreover, the existing *culturally decontextualised* school mathematics curriculum has given rise to controlled (disengaged) pedagogy to “get things done” or finish the course without paying due attention to students’ perspectives, which enforces students learn only the algorithmic problem solving skills through practice and drill method and rote-learning method to be trained for *standardized tests* (Luitel, 2009; Shrestha, 2011).

Above all, I come to realise now that what I did in the former part of teaching career was that I just developed a culture of linear teaching and learning of mathematics in the classroom which might be due to my pedagogy as/for microscopic teaching conniver: the reductionist pedagogy that micromanaged students’ learning in the name of meaningful learning while students just developed a culture of following a sequential path of learning provided by their teacher, teacher’s lesson plan, textbook or curriculum.

Pedagogy as/for Emergent Phenomena Resister

“Sir, I can do it in the classroom but can’t do it at home.”

“I understand everything in the classroom but forget all while doing homeworks.”

"Sir, I had practiced many times till late night but forgot all in the exam."

"Sir, I can do it when you are with me but can't do when I do it alone."

These issues of my students remind me the assertion of Denvir and Brown (1986) who stated that mathematics is not learned in a linear, unidirectional, ladder-like fashion. It also reminds me that there still exists a hegemonic impact of reductionism on pedagogic-, and assessment-related practices of mathematics education (Luitel, 2009). Moreover, I come to realise now that as a conventional teacher, I often promote linear teaching and learning of Mathematics due to disempowering features of reductionism in mathematics education. Otherwise, my students could have been able to learn, at least, the skills of solving mathematics problems alone without the help of teachers. Nonetheless, they had no/less confident of solving mathematics problems in the classroom or in the examination hall. Why did it happen? Was it due to my overuse of reductionist pedagogy in teaching and learning of mathematics?

I think that I never tried my best to inquire the emergent attributes and phenomena of mathematics at all. For example, I always taught geometric theorems to my students so that they could learn how to prove them. But I never taught them why they were learning theorems. I taught Algebra to factorize and simplify but never taught where my students could use Algebra in their practical worlds. I taught arithmetic to my students but never tried to tell them how they could be linked to their everyday lifeworlds. Instead, I always persuaded them to learn the facts, formulae and procedures so as to get the outcome as finished product. Directly or indirectly, I often gave rise to micromanaging details of students' learning under teacher's control, thereby undermining the students' active participation in classroom interaction. According to Novak (2002), Ausubel distinguishes between rote learning, where new information is uncritically accumulated in the memory and meaningful learning, where new ideas are analytically evaluated and integrated into what the student already know (as cited in Foster, 2013, p. 577). It means that I often gave preference to rote learning and subordinated/neglected meaningful learning of mathematics for students.

Above all, did my pedagogy resist the emergent phenomena of mathematics? How did I resist them? What are these emergent phenomena? I am now thoughtful about the emergent properties of mathematics. I remember about the different natures of mathematics such as pure and impure (Luitel, 2009, 2013), absolute and fallible (Ernest 1991, 1994). According to Luitel, the pure mathematics gives rise to an exclusive focus on an ideology of singularity, epistemology of objectivism, language of universality and logic and genre of certainty while developing curriculum, conceiving pedagogies and implementing assessment strategies in school mathematics education and mathematics teacher education. While Ernest urges that absolute mathematics is incorrigible, rigid, universal and objective. Whatsoever, I think I had been teaching such as pure and absolute mathematics to my students since the time I started my career. Then, what could be the emergent properties of mathematics? Are they impure and fallible? Or do they lie underneath *wabi-sabi* mathematics (Maheux, 2016)? What are impure, fallible and *wabi-sabi* Mathematics then?

According to Luitel, impure mathematics includes informal, artefactual, communal, ethnic and indigenous mathematics while Ernest claims that mathematics is not absolute rather it is fallible which is subjective as it can be corrigible overtime and is validated through series of public discourses (especially mathematicians, philosophers, teachers, etc.) and finally that knowledge is conceived as objective knowledge. Maheux (2016) asserts that "*wabi-sabi* mathematics is concerned with earthy, irregular, imperfect, textured, intuitive, relative, ambiguous, contradictory, and so on" (p. 176). For example, such mathematics can be found in roughly hand-made teacups. Can we integrate such emergent attributes of mathematics in the curriculum of Nepal? Up till now, not, but I envision such mathematics in the curriculum.

Therefore, by reducing mathematical objects (knowledge), tiny parts do not represent the whole rather the whole is more than the sum of its parts because of the emergent properties of mathematical objects. For example, an algebraic expression $x^2 + 5x + 6$ represents the area of a rectangle while its parts $(x + 2)$ and $(x + 3)$ represent its sides (i.e. length and breadth). In this case, I always teach as to find the product instead of offering them to discuss what this product represents. They simply found the product as beforehand outcome but never got any opportunity of analysis and interpretation.

While teaching in Grade VIII, I could have given some circle of different diameters and allow them to discuss in groups to find out the value of $\frac{Circumference}{Diameter}$. Instead, I directly told them that its value is always constant that is merely equal to $\frac{22}{7}$ or 3.14. If they had been given an opportunity of experimenting it, they would have found its value as an emergent attribute of circles.

I would rarely give complex problems to my students. Whenever I gave such complex problem, either I would immediately assist the students in solving it or I would solve it without allowing them time to analyze the problem. For example, I would often prove all the possible unseen complex geometrical theorems of Grade X, which were already asked in the SLC examination and the asked them to learn it by hook or crook. They would follow practice method, which made them able to prove those theorems. However, in case any question which they had never seen before were asked in the exam, they would leave it in the exams as they had got no any skills of proving such theorems. However, it was also true that some outstanding students could prove such theorems; maybe, they learned it by ‘learning by doing’ method.

I often taught the different topics of Mathematics subject as discrete tasks and concepts. I merely tried to link them to each other. More so, I hardly linked mathematics to other subjects as an integrated curriculum concept. Rather there was an unfair competition among subject teachers to prepare students to score the highest marks in the SLC examinations in their subject so as to get rewarded from school. For example, once a social studies teacher complaint to the Principal that the students of Grade X have no any idea of drawing pie-chart. As a result, the Principal called me in the office and scolded me. From that time, I never taught pie-chart meaningfully in Grade IX as they didn’t have to study it in Grade X in Mathematics. Finally, the teacher had to teach himself from the basic, but one day he approached me and apologized. Since then, I taught it in Grade IX meaningfully.

Neither did I link Mathematics to the students’ everyday lifeworlds, nor did I encourage them to find their cultural mathematics. It was after I joined MEd in KUSOED in 2007 when I gradually understood what Mathematics was all about. Since then I gradually began to link academic mathematics to outer world and cultures of students. Even, I designed different project works for my students such as Cultural Mathematics, Contextualisation of Mathematics Education, Contextualisation of Algebra, Algebrification of Trigonometry, etc. so that they could learn the emergent properties and phenomena of Mathematics, other than textbooks.

“Please, do fast. We are running out of time.”

“How long are you taking to do such a simple problem?”

“Oh, it’s too much! … You are good for nothing … lazy bones like a tortoise …”

These were my common words I would speak up loudly in the classroom when my students were given to solve any problem. I always resisted students from doing problems for long time because of lack of time or intention of making students quick-algorithmic-problem-solvers. I was always in rush in jumping into the next topic. Instead, I could have given sufficient time to my students to explore different ways of solving the same problem without any pressure to arrive at an answer quickly.

There is a popular adage, “students learn my mistakes”. But I hardly encouraged my students to do mistakes so as to learn meaningfully. I always enforced students to do their works fairly in the exercise and never entertained their mistakes, over-writing, and dirty hand writing. Instead, I could have encouraged them to do mistakes and get confused, and not to move quickly while doing problems. If I had done such, they would have become good critical thinkers and creative learners. This is how I am in the process of self-realisation of my intentional or unintentional mistakes.

Beginning the lesson with definition, explaining with illustrative examples, doing problems on the board and asking students to copy, giving the similar examples based on the grade-works, never letting students think critically, etc. were some disempowering features of my reductionist pedagogy. I think such disempowering features always limited my students within my control thereby coercing them to follow smooth-path learning and subordinating/neglecting non-linear aspects of learning. I still remember that I was totally against various methods of solving the same problem as I would think that learning more than one method of solving the single problem would kill their time. I had a belief that by learning various methods, students might become a "Master of all but Jack of none", which would cause ambiguity during the examination.

Recapitulating the Chapter

In this chapter, I presented six narratives to portray what, how and why disempowering features of reductionist pedagogy persuaded me to promote only linearity in teaching and learning of mathematics. Being a novice mathematics teacher, I extracted pedagogical content knowledge (PCK) as sacred knowledge from my ancestors (gurus, teachers, parents, etc.) and transmitted to my students as it is. I come to realise now that despite having content knowledge, I as a teacher must acquire PCK as well to successfully teach students mathematics. In this regard, Shulman (1987) defined PCK as the most regularly taught topics in one's subject area, the most useful forms of representations of those ideas, the most powerful analogies, illustrations, examples, explanations and demonstrations – in a word, ways of representing and formulating the subject that make it comprehensible to others. Further, Grossman (1990) articulated four general PCK categories: (1) an overarching knowledge and belief about the purpose for teaching; (2) knowledge of students' understandings, conceptions, and potential misunderstandings; (3) knowledge of curriculum and curricular materials; and (4) knowledge of the instructional strategies and representations for teaching particular topics. Since I had not taken any degree of Mathematics Education from any University when I formally started my pedagogical voyage, I had less/no idea about what Shulman and Grossman asserted. Nonetheless, I was confident in content knowledge but had no any former PCK except some experiences of teaching coaching classes and private tuitions.

Based on above six narratives, I confess that I used the skills of explaining contents through illustrations and examples but hardly used the demonstrations in my former part of teaching career. Instead, my pedagogy helped me in transmitting content knowledge of subject; I used pedagogy as finished product practitioner to persuade my students to practice the problems having beforehand outcomes; I used pedagogy as target hitter to coerce my students to set a target for the exams; I used pedagogy as bigger sight loser to break down the problem into tiny parts and use laws, rules, formulae, etc. to get the beforehand outcome, thereby persuading students to be deprived of bigger picture of mathematics; I used pedagogy as microscopic teaching conniver to produce students acquiring the culture of moving along the teacher's plan; and I used pedagogy as emergent phenomena resister to persuade my students to follow smooth-path of learning, thereby resisting them from learning the emergent phenomena of mathematics.

At this point, I have an issue: What disempowering forces persuaded me to follow only the reductionist pedagogy, giving rise to linearity in teaching and learning! According to Luitel (2009, 2013), there are mainly three disempowering forces in mathematics education in Nepal, which have been persuading mathematics teachers to follow reductionist pedagogy, and they are culturally decontextualised curriculum, disengaged pedagogy and sit-for-test assessment system. I also believe now that the curriculum and assessment system of Nepal have been promoting reductionist pedagogy as a disempowering force in teaching and learning of mathematics in schools. More so, these three disempowering forces gradually give rise to many subsequent disempowering forces such as work-load, school's pressures, parents' high expectations, anxiety, high temperament, etc., thereby creating dilemma of what to do or what not to do in mathematics teaching and learning processes. My lived experiences also reveal that such conventional methods of teaching have been prevailing in schools in Nepal, which are guided by traditional theories (e.g.

behaviourism) that assumes that knowledge is objective that is set in our mind as an image, and can be judged as 'true' or 'false'. It means that 'true' corresponds to reality and 'false' corresponds to imaginary. Therefore, knowledge is a search of reality. von Glasersfeld (as cited in Bodner, Klobuchar, & Geelan, 2001, p. 3) argues that "the traditional theory searches for a match between knowledge and reality in much the same way that one might match samples of paint. If they are not same, they must be different." That's why; grown with conventional culture of learning, I think that almost certainly I continued the same culture of teaching mathematics using the reductionist pedagogy.

If we imagine the classroom setting, then traditional theories portray a fixed setting where teachers transmit knowledge to students who receive it as reality and "transmission promotes the technical interest because it does not seem to provide students with opportunities to communicate about mathematical concepts on their own terms" (Luitel, 2009, p. 84), and the students' evaluation is based on "the system of only sit-for-test exams as a means of assessment" (Luitel & Taylor, 2007). Such pedagogical problems are prevailing in schools in Nepal giving rise to reductionist pedagogy promoting smooth-path learning of mathematics for students.

In the last two decades after the re-establishment of democracy with the fall of autocratic *Panchayat* regime in Nepal, many academicians and educational researchers began to focus on reforming school education system for all round development of students in the nation. In 2007, the curriculum development centre (CDC), Nepal came up with an ambitious programme for all round development of the nation through well managed school education system. The main bases in developing this framework are socio-economic, political, cultural and educational contexts, and this framework has laid emphasis on globalization, modernization, decentralization, and localization of curriculum in the Nepalese context (National Curriculum Framework for School education in Nepal, 2007). Similarly, the Ministry of Education, Nepal adopted participatory and consultative process for the development of the School Sector Reform Plan (2009-2015) that built on the EFA (Education For All) and SESP (Secondary Education Support Programmes) with main goal " To foster children' all-round development, laying a firm for basic education", and main objectives "To expand access to quality ECED (Early Childhood Education and Development) services for children of four years of age t prepare them for basic education."

Despite putting these efforts, the education system in Nepal has turned out to be a tough gulp for the stakeholders, because in the last few years the SLC (now SEE) results of mathematics have given a signal of wearisome future of education system in Nepal. The major drawbacks of such grand plans can be observed while implementing them in the classroom situations. Though these reforms have put their efforts in incorporating contextual problems in the curriculum, "the culturally decontextualised curriculum, an unpreparedness of in-service and prospective teachers and the sit-for-test assessment system have prevented students from a meaningful, authentic and inclusive learning of mathematics in the classroom (Luitel, 2009). More so, mathematics is taught for increasing higher percentage in SLC (SEE) which mechanically puts much pressure on teachers to train students through practice method of teaching and learning, just like animals are trained in circus, thereby giving rise to reductionist pedagogy. As I mentioned in the above narratives, I as a conventional teacher have also experienced more or less the same. Instead of teaching mathematics by connecting it to the real-life problems, I had/have to follow the lecture (practice) method encouraging my students for practice method.

Mathematics education in Nepal begins with a painful history by undertaking the west-centric (British) curriculum via India (Luitel, 2012). With growing political changes for the establishment and re-establishment of democracy and *federal system* in Nepal, the Curriculum Development Centre (CDC) Nepal has deconstructed and reformed the curriculum of mathematics education with the support of foreign aids (e. g. Asian Development Bank, UNESCO, etc.) to produce the *"culturally decontextualised mathematics education*' guided by Western Modern Worldview (Luitel, & Taylor, 2013). The problems begin from here as the mathematics we have been teaching for long is west-centric, and its hegemony in mathematics curriculum is privileged to generate "students being indoctrinated into it *as though* it is a doorway into an inevitably superior worldview" (Luitel & Taylor, 2007, p. 640). Then, how can we realise the need for a justifiable, culture sensitive and inclusive mathematics education in Nepali schools and universities?

Based on my lived experiences and contradictions, I believe that I was provoked to use reductionist pedagogy because of three disempowering forces – culturally decontextualised curriculum, disengaged pedagogy and sit-for-test assessment system in Nepal. Let me interpret these three disempowering forces:

It could be any day of June 2015. When I interacted with the Principal of the school, he freely expressed his views on how curriculum has become one of the major disempowering forces in meaningful learning of mathematics. After my interaction with him, I came to realise that the school mathematics curriculum lacks the coordination between theory and practice. The principal said, "*There is a gap between mathematics curriculum and practice. Whatever we teach our students in the classroom is limited to the textbook. The mathematics curriculum is not able to address the students' practical aspects. For examples, those things of geometry* *teachers teach can be explained by a carpenter, but our students are unable to express them. We teach our students to find the area of four walls, but if we ask them to find the area of the wall of their classroom, it will be their hard time to calculate it.*

I also interacted with the first girl of Grade X. Upon interaction with her, she expressed her views in a different way on curriculum of mathematics (Moreover, I explained her meaning of curriculum). She told that the curriculum should be different than what it is now. She elaborated, "*This mathematics book has got nothing that makes us joyful. … Nothing to enjoy from learning mathematics! … There is no any cultural and practical flavour like in social studies, EPH … But we have to do hard labour to get higher marks in exams…*" She further added a different view on curriculum, "*This (Mathematics) curriculum is full of problems borrowed from foreign lands – Britain, France, India, America, Greek, totally Western math …*"

I also interacted with a (weak) student who merely would pass Mathematics in any test or exam. Upon interaction, he told me that he had less idea about curriculum. However, after I elaborated it briefly, he admitted that mathematics curriculum should include the cultural aspects of Nepalese people such as mathematics of different ethnic people. After that he was not comfortable to talk about curriculum any more.

Based on the views of reality these three participants expressed, I feel that mathematics is more or less orientated towards *algorithmic problem solving* and teachers usually encourage their students for theoretical understanding, thereby subordinating the practical aspects of mathematics. More so, my belief regarding *mathematics as foreign subject* (Luitel, 2009) is strengthened by the views expressed by them, because the existing school mathematics curriculum in Nepal incorporates mostly the contents advocating Western Modern Worldview, thereby subordinating Nepali Cultural Worldview (Luitel, & Taylor, 2008). Regarding the view about providing enjoyment, I admit to the girl's saying that there is no any contents that encourage students to enjoy while learning mathematics. Here, I assume that she might be expecting some contents which she could find in other subjects, such as mathematical games, stories, poems, songs, etc. I also now believe that directly/indirectly this mathematics curriculum encourages students to follow 'practice method' and 'rote-memorization of formulae' ultimately to achieve higher percentage in exams.

Further, the Principal openly put his opinion regarding the heavy course contents, which is the prevailing issue raised by many scholars and teachers in Nepal. He pinpointed that *the contents in this (mathematics) curriculum is very heavy, but lacks its application in everyday life.*

His concern about local curriculum encouraged me to inquire his views about cultural mathematics being practiced in Nepal and he elaborated it with examples, "*For example, Newars are businessmen in Nepal. They need practical mathematics at all, not (only) the mathematics of the textbook … In our village, there is a practice of calculating informal mathematics although they have not learned academic mathematics. They use hands to measure things such as length, land, etc. … Damai, Kami and Sarki*[7] *who have never gone to school can do their jobs without having any idea about academic mathematics. Pundits (Brahmins) in our village know how many "japs"*[8] *should be recited in a ritual work according to the context. Newars, Rais, Limbus, Magars, Gurungs, Tamangs,*[9] *etc. know how much water should be mixed to make rakshi*[10]. *There is much local mathematics which should be included as a local*

[7] Damai, Kami and Sarki are so-called lower-caste people, whose traditional businesses are respectively sewing cloths, making iron objects, and making shoes according to caste-system.
[8] The term 'jap' is about the practice of reciting mantras while worshipping gods.
[9] Newar, Rai, Limbu, Magar, Gurung and Tamang fall under the ethnic groups of people who have a practice of making local wine from rice, millet, etc.
[10] The term 'rakshi' refers to a type of wine which is made locally in the villages.

curriculum in the academic mathematics. Local curriculum is a vital issue. But whatever mathematics curriculum we are learning and teaching is a deliberately imposed curriculum which is not able to address local curriculum.

Above all, I come to realise now that curriculum is one of the main disempowering forces that influence meaningful learning of mathematics in the sense that it is heavy in contents and the contents are not inclusive of local and cultural mathematics, thereby persuading teachers to follow reductionist pedagogy. However, I also feel that the mathematics curriculum needs reform so as to include such mathematics of people that have direct impact in their everyday life activities along with the existing contents that reproduce the so called Western Modern Worldview. My concern is how this mathematics can help students learn mathematics meaningfully. Is the existing mathematics curriculum good enough for meaningful learning of mathematics? How do I justify which aspects justify a meaningful learning of Mathematics? Form the views expressed by the participants, it seems that local and cultural mathematics can also be one of the components for meaningful mathematics learning. Then, is the existing mathematics curriculum with heavy contents doing justice to students for meaningful learning? From the participants views, I now feel that only variety of heavy contents do not serve students meaningful learning, rather they create many disempowering forces such as mainly math anxiety that leads students to failure in understanding mathematics in a meaningful way.

In 2015, might be in the cold month of December, I interacted with a boy of Grade VIII. I asked him why he was so weak in mathematics. He said to me, "*I was good in mathematics up to grade IV. … But from grade V, I became weak in math. Since then I understand 50 % and do not understand 50 % …*" I tried my best to delve into his hidden story to find out why he was weak. In the beginning, he was uncomfortable to share his hidden stories, but upon my conviction of not disclosing his story to anyone, he was ready to unfold his hidden stories that had been untold for more than five years. "*Sir, the teacher in grade V was not like you … I mean he did not make us things clear … he was too strict and would give physical punishment. He just would write the question on the whiteboard and start solving … After that he would ask us to do problems. It was too difficult to understand … He would focus on only intelligent students … No care for weak students like me … After all I failed in first term exam in Grade V. Since then, I have never passed mathematics, though I am promoted in every class with grace marks … But now I understand it to some extent because you teach very basic things before teaching any topic … you help weak students … You are taking remedial classes to weak students like me … Now I am sure this time I will be able to pass in the upcoming first term exam.*

Similarly, it could be January 2017. I talked to a very smart girl of Grade X and asked how she became so good in Mathematics. She also had an interesting story. She said, "*In my childhood, I would get less marks and therefore had no interest in mathematics. However, in grade III, a new Miss (teacher) came. Her love, care and ways of teaching mathematics made me curious to learn mathematics. Since then, my interest towards mathematics was raised and I started doing better and better till today.*

All the narratives of these participants and those six narratives convinced me that pedagogical practices of Nepali teachers have a reductionist flavour influencing students' learning of mathematics. Most importantly, from the subjective realities I drew from these narratives, I believe that teachers are one of the many key factors of promoting or demoting students' learning of mathematics. Teachers need to know various PCK so that the contents can be contextualized, thereby enhancing meaningful learning of mathematics in the classroom. How can pedagogy be helpful for meaningful learning of mathematics? Only reductionist pedagogy in which teacher is in active role and students are only the recipients is persuading students to reproduce *sacred* knowledge transmitted by their teacher. It also seems to me that the *only* reductionist pedagogy kills the creativity of students; it does not allow students to imagine, create, pose questions and solve them through cooperative/collaborative learning. Therefore, I come to realise that such a reductionist approach of teaching persuades both teachers and students to promote linearity in teaching and learning of mathematics in the classroom.

My lived experiences and contradictions (Whitehead, 2008a) reveal that the assessment system for evaluating students' performances during their academic year has become a major issue of discussion among scholars and teachers. When I interacted with colleague teachers and students, most of them were unhappy with the assessment systems of Nepal. They were in favour of incorporating in the assessment system the overall aspects of students, rather than evaluating students' performances only through closed exams conducted in a fixed period of time. Amazingly, recent reform in curriculum by CDC, Nepal ruthlessly did not include practical exam for Mathematics while other subjects have theoretical exam of 75 or 80 and practical exam of 25 or 20 out of 100.

Regarding this, I asked some students. A girl of Grade X said, "*It is too unfair to evaluate us just by one written exam … Sometimes, we become sick and consequently we miss the exam and fail. … If we were evaluated on the basis of our classroom activities like practical activities, we would have scored better in the exams … How can we be evaluated on the basis of what we have learned only from textbooks? … In all subjects, there is practical exam, but in Maths … no practical* *exam … so frustrating!"* She told me many issues which I had not expected. My long experience in the field of education has also taught me lesson that students shouldn't be evaluated simply by three-hour written exams. In my opinion, such practice of assessing students enforces teachers to encourage students for 'practice method' and 'rote memorization of formulae'. Being a teacher, I have also felt that such a sit-for-test assessment system puts much pressure on teachers, because of which teachers have to ultimately follow the reductionist pedagogy. That's why; I also admit that the assessment system should constitute both theoretical and practical aspects.

In the same way, I interacted with the Principal of my school. He said, "*I am totally against the decision made by CDC. They must have also included practical exam in Mathematics in SEE like in other subjects. Regarding term exams, those term exams are not the evaluations of students' performance, rather they examine what they wrote in exams. Evaluation is about their participation in teaching-learning activities in the classroom, such as their oral expressions, presentations, reflective capacity, practical performance, project based learning capacity, etc.*

This examination system is able to test only certain skills of students; it cannot test overall skills of students. That's why; it is necessary to reform the assessment system in Nepal … More so, we being master degree graduates cannot measure land, cannot check whether our house is tilted or not due to the Earthquake … Even we have no guts to build houses by ourselves during this disaster and we seek for Government help … Moreover, our education system is guided by "puchcharvaadi soch" (tail-ism) in philosophy .. We have a habit of seeking help of experts … Our society is driven by an ideology of how much marks is achieved by students rather than what students learn … Math subject is not able to do justice to our society, rather it has done justice *to our institution (smiles)… Most bitter truth is that because of failing in mathematics, many students are compelled to drop out of education …*

This comprehensive interaction with the Principal made me think about how our assessment system is failing to enhance meaningful learning of mathematics in the classroom. I also believe that only the term exams as a means of evaluating students' performances is incomplete and there should be developed a system that evaluates students' overall performances so that all of us do not run after marks obtained by students, rather we acknowledge what our students learn during his/her schooling. Therefore, it seems to me that the assessment system in Nepal should be reformed so as to evaluate students' overall performances, thereby encouraging students for their active participations in classroom activities, which ultimately enhance meaningful learning of mathematics.

Key Message of the Chapter

Based on above reflection and interpretation, I come to realise that there are three major disempowering forces in mathematics education in Nepal, namely culturally decontextualised curriculum, disengaged pedagogy and sit-for-test assessment system, which give rise to reductionist pedagogy that persuades both teachers and students to promote linearity in teaching and learning of Mathematics. I think if the mathematics education in Nepal overcomes these disempowering forces, both teachers and students will most probably be looking for some alternatives for linearity in teaching and learning of mathematics. Then, what could be the possible solutions for such disempowering forces? How can I overcome the reductionist pedagogical practices so as to promote meaningful learning in mathematics? What are the alternatives for the reductionist pedagogy in mathematics teaching and learning? I will deal with these issues in the next chapter.

CHAPTER IV

NON/LINEAR MATHEMATICS PEDAGOGY: REALISING MEANINGULNESS

In the previous chapter III, I articulated how and why I was restricted within the false consciousness of hegemonic reductionist pedagogy. More so, I portrayed what disempowering features of reductionism in mathematics education provoked me to promote often linear teaching and learning of mathematics in the classroom. Therefore, I could critically reflect upon and re/examined my pedagogical practices, and explored my pedagogical ecotone and students' learning ecotone between the cognitive and affective domain due to hegemonic reductionism. Moreover, I could find how the hegemonic reductionist pedagogy gives rise to linearity in teaching and learning of mathematics, thereby increasing gap between teacher and student, and between mathematics and student because of over-emphasis on cognitive domain and less/no-emphasis on affective domain of both teacher and students.

Subscribing to the chapter III, in this chapter IV, I have articulated how both linear and nonlinear approaches could be incorporated in my pedagogical practices for meaningful teaching and learning of mathematics in the classroom. Therefore, this chapter IV addresses my second research question, '*As a teacher-researcher with transformative sensibility, how do I incorporate non/linearity in the teaching and learning of mathematics so as to reduce my pedagogical ecotone and students' learning ecotone?',* and explores how I came to realise the meaningful aspects of nonlinear teaching and learning of mathematics and incorporate both linear and nonlinear aspects of teaching and learning of mathematics so as to reduce my pedagogical ecotone and students' learning ecotone. I have presented five narratives: *Improve Your Language Skills: Becoming a Language Teacher, Problem Solving or*

Reproducing Algorithms! Realizing Nonlinear Mathematics, Where Do We Use Algebra? No Benefits In My Whole Life!, Touching the Untouchables: Paving the Nonlinear Path, and *Look into Yourself! Becoming a Critical Reflective Teacher.*

All the narratives portray how my ways of knowing (epistemology), ways of being/becoming (ontology), ways of valuing (axiology) and ways of sensing (aesthetics) gradually got transformed than ever after I joined my master' study.

Let me present a poem that describes how I realised that I reinvented me as a conformist teacher having acquired 'I-actor' as a reductionist character, thereby dreaming, imagining and creating to become a teacher with transformative sensibility.

Peering into the Inner-self

Peering into my 'inner-self',
Thinking mindfully about 'being',
Recreating the landscape of my pedagogical practices,
Realising linearity in my pedagogical practices,
I reinvented my character as a conformist teacher.
Unthinking - Where is mind?
Mind in my head?
My head –
A thick cloudy mechanistic box,
Full of cognizing instruments –
That invented my mathematics pedagogy,
That gave birth to my 'I-actor',
That fabricated my character of viewing the 'whole from its parts'
That erected me as a reductionist teacher.
Thus,

Dreaming, Imagining and Creating!

Thoughtful about ‘becoming’,

Imagining my inner ‘self’ relative to ‘other-selves’,

Realising the ‘otherselves’ empathetically through a new ‘self’

Creating a space of both cognitive and affective dimensions,

Seeking for both linearity and nonlinearity of my pedagogical practices,

To re/invent the ‘self’ relative to ‘otherselves’,

To become a teacher with transformative sensibility.

Improve Your Language Skills: Becoming a Language Teacher

“Sir, I don’t understand the question!”

“Sir, if you explain the question, I can do it.”

These were the voices of students which I often heard, and I would say, *“Improve your English language skills! Otherwise you will be having the same problem in your whole life.”* However, after becoming a student of mathematics education at KUSOED, I gradually became an inquisitive learner and an enthusiastic teacher, so far and always tried my best to teach mathematics meaningfully in the classroom. More so, I realised the importance of “critical reflection” to become a qualified teacher (Mezirow 1990) and began to practice “critical reflection as a framework for transformative learning in teacher education” (Liu, 2013).

Nonetheless, there were many challenges in front of me, some of which were seen and connected to my mind and heart while the others were unseen and disconnected, yet to be faced. Gradually, I was grooming myself theoretically while I was confronting with ‘theory into practice’. What would I do? Were there any ways of knowing? What were my ways of being or becoming? My ways of thinking got distorted and hence I began to think nonlinearly, thereby forgetting the Cartesian thinking and acting, and realizing that our "education has been traditionally been based on linear thinking models and styles due to the influence of the Newtonian cause-effect analysis, and the Cartesian geometric representation of objects" (Bratianu, & Vasilache, 2009, p. 6). In this regard, let me present a narrative depicting students' language difficulties in understanding mathematics literacy.

It could be in 2014, the hot summer day and it was just a month passed since the new academic session of the school. About 15 students of Grade IX were waiting for my presence in the classroom just after school in the remedial grade. I entered the classroom and made up my mind to test their actual cognitive level of development using Vygotsky's ZPD. For this, I tested their level of English language proficiency in math learning ordinarily as follows:

	Write mathematical statements for the following:
1	Sum of x and y
2	Difference of x and y
3	Product of m and n
4	Quotient of a and b
5	x is two times of y
6	x is greater than y by 1
7	a is less than b by 2
8	x is increased by 5
9	y is decreased by 7

Most of the students were able to write the correct answers of 1, 2, 3, but almost all students could not write the correct answers of other questions. Their answers varied which I tabulated below:

	Questions	Mathematical Statement written by the students	Correct Mathematical Statements
1	Sum of x and y	x + y	x + y
2	Difference of x and y	x – y	x – y
3	Product of m and n	m × n; m.n; mn	m × n or m.n or mn
4	Quotient of a and b	*(Nobody could answer it)*	a ÷ b or $\frac{a}{b}$
5	x is two times of y	2x = y	x = 2y
6	x is greater than y by 4	4x = y	x = y + 4 or x – y = 4
7	a is less than b by 2	a = 2b	a = b – 2 or b – a = 2
8	x is increased by 5	+ 5x	x + 5
9	y is decreased by 7	– 7y	y – 7

When I came to realise that the students of Grade IX were having language problem in learning math through English as a medium of instruction, even of the level of Grade 6/7, I was stunned because I thought that I might have given a major focus on my teaching by transmitting "procedural and conceptual knowledge of mathematics" (Rittle-Johnson, Siegler, & Alibali, 2015) in the name of developing the instrumental understanding and relational understanding (Skemp, 1970) of mathematics, thereby subordinating/neglecting their English language skills. I immediately discussed about this issue with the Principal of the school. After discussion, the school circulated a notice to all the teachers and students to be more serious than ever in enhancing English environment in the school. I also interacted with English subject teachers to find ways of improving the students' English language skills and discussed the possible ways of developing students' understanding of mathematics using English as a medium of learning.

Having come from different ethnic and cultural backgrounds, students had (have) to learn English and it was (is) a bitter experience for them. Most importantly, English is an international language of communication and has been increasingly gaining its popularity in Nepal, which provokes parents to admit their wards to the private English boarding schools in Kathmandu valley so that their wards would become good in English language. Then, what would I do to improve students' skills of understanding math questions? This issue made me thoughtful.

For this, I also discussed with the Professors of the KUSOED to find out the possible ways. The Professors suggested me to use "Content and Language Integrated Learning (CLIL)" (University of Cambridge ESOL examinations, 2008) approach in teaching and learning of mathematics in English as a medium of instruction. Upon interaction with the students, I firmly believed that one possible way of enhancing students' learning of mathematics could be a teaching mathematics using the CLIL approach and hence immediately discussed with the Principal of the school about the CLIL, which is "a dual-focused educational approach in which an additional language is used for the learning and teaching of content and language with the objective of promoting both content and language mastery to predefined levels"(Mehisto, 2012, p. 15). I made lesson plans which included rote learning and practice methods, quiz, matching-columns, etc.

Teaching/Learning by Rote Learning and Practice Methods			
Vocabularies	Meaning/Explanation	Vocabularies	Meaning/Explanation
Sum	result after addition (add)	Product	Result after multiplication (multiply)
Difference	Result after subtraction (subtraction)	quotient	Result after division (divide)

Times	Multiply	double /twice	Multiply by 2
triple/thrice	Multiply by 3	Four times	Multiply by 4
half of	Multiply by $\frac{1}{2}$	One-third of	Multiply by $\frac{1}{3}$
Two-third of	Multiply by $\frac{2}{3}$	Four-fifth of	Multiply by $\frac{4}{5}$

After spending two/three days for teaching basic technical terms and their meaning by using rote learning and practice methods, I also conducted quizzes and matching-columns in the classroom individually as well as forming groups.

Match the following in two columns	
Sum of m and n	$\frac{x}{6}$
Ten times of p	m – 3
Half of (x + y)	15xy
x divided by 6	2z
Product of 5x and 3y	$\frac{7a}{14}$
m is decreased by 3	m + n
7 is increased by 4y	10p
Z is doubled	$\frac{1}{2}(x+y)$
Seven-fourteenth of a	7 + 4y

After about a week, I gave the tests in which all the students scored above average marks (above 50 %). After this, I integrated the CLIL approach in mathematics teaching and learning though it was a tough gulp for me to implement exactly according to the CLIL principles. Moreover, gradually I felt that the integration of English language into math teaching and learning helped me and my students as well improve the skills of teaching and learning of mathematics, so far. I still remember one student who frequently chats with me in Facebook and reminds me how I helped him improve his English as well as Mathematics learning. He was a student who was very weak in Mathematics as well as in English. In fact, I suggested him to read English story books, biographies of great persons, etc. and watch English movies and English news channels such as BBC, CNN, etc. to improve English language. He now reminds me that he did all and gradually improved his English and hence is residing in London now, the credit of which he gives to me. Here, I must admit that I also improved my English language skills which were due to my MEd and MPhil studies at KUSOED as I had to read various research papers, journals and articles and write assignments and papers in English.

Now, the CLIL approach of teaching has become a true friend of mine which assists me in explaining mathematics explicitly and in turn, students feel comfortable to learn mathematics with me. Nevertheless, I confess that only English as a medium of instruction has not been complemented my total teaching of mathematics for meaningful learning, rather sometimes I also have to use Nepali as a medium of instruction despite being threatened by the school. It is because I have transformed my ways of linear thinking and acting to nonlinear ones which have become my culture to find out various ways of instructions in the classroom.

I still remember a lived experience: While teaching the topic 'heights and distances' for Grade X, I often feel so awkward and complexity as well due to English language that I fear to teach it in the beginning of the academic session. I usually teach it in the latter part of the session after grooming my students. Nonetheless, I try my best to use the CLIL approach and for this I also use the reductionist approach of teaching and learning which helps me and my students break down the compound (complex) sentences into simple sentences and draw the figure accordingly. For example, “The angle of depression and elevation of the top of a pole 25 m high from the top and bottom of a tower are 60^0 and 30^0 respectively. Find the height of the tower.” I first explain how the single complex sentence is made up of two simple sentences by picking up the words such as angle of depression, top of the pole, from the top of the tower and 60^0, and help them make a complete sentence “The angle of depression of the top of the pole from the top of the tower is 60^0.” Next, they separate the words such as the angle of elevation, the top of the pole, from the bottom of the tower and 30^0, and write a complete sentence “The angle of elevation of the top of the pole from the bottom of the tower is 30^0.” On the basis of these two simple sentences now they draw the figure and solve the problem to find the height of the tower.

“Sir, I think ‘height and distance’ is the most difficult topic in Mathematics.”

“Sir, our seniors told us that ‘time and work’ is also tough to understand.”

“Sir, so tough to understand the questions of compound interest, marked price and discount, profit and loss, and so on … I am just blind in verbal problems …”

These are the concerns of most of the students about mathematics learning in schools.

When I began my MPhil study at KUSOED in 2014, I gradually improved my academic reading and writing skills due course of time. My course Facilitators always encouraged me to help my classmates improve their reading and writing skills while doing their assignments. I was (am) often given to review research journals, articles and theses. They have also given me the responsibility of External Examiner of master’s theses. Most importantly, because of my good performances in MPhil examinations, I was given to teach the master’s course “Curricula in Mathematics Education” in 2015. Since then, I have been teaching the same course and miraculously, from the August 2017, I have got to teach the other course “Recent

Paradigms of Mathematics Learning" for master's students. Besides, I have been guiding my classmates and master's students in writing their theses and proposals. In 2015, I developed the Self-Learning Materials (SLM) of the course "Curricula in Mathematics Education", and worked as a member of the core researchers in designing and developing the curriculum of Early Grade Mathematics Assessment (EGMA) in 2016 supported by KUSOED, World Education, Nepal and Curriculum Development Centre (CDC), Nepal. Above all, I feel that I have been journeying into improving the CLIL approach of teaching mathematics, so far.

Next, let me present an anecdote that depicts how I helped master's students in improving their academic writing skills.

"Sir, we want to improve our academic writing skills. Would you please help us?"

"How shall we improve writing narratives, Sir?"

"How shall we link our narratives to the literatures, Sir?"

These were (are) some concerns of my master's students. While teaching the course 'Curricula in Mathematics Education', I have found English as a medium of instruction as one of the barriers for students in learning mathematics meaningfully in the classroom. Moreover, the difficult research journals, articles and theses have also caused problems for students in understanding the main theme conceptually. In this regard, I help(ed) them by reading the paper sentence by sentence and explaining the conceptual meaning explicitly with the help of various illustrative contextual examples. I use(d) the cooperative and collaborative learning methods in the classroom and ask(ed) them to write their reflection in the classroom. Sometimes, I also used "Jigsaw method" of cooperative learning (Johnson, & Johnson, 2005; Azmin, 2015) which has the following 10 steps in Jigsaw-classroom:

1. Divide students into 5- or 6-person jigsaw groups. The groups should be diverse in terms of gender, ethnicity, race, and ability.
2. Appoint one student from each group as the leader. Initially, this person should be the most mature student in the group.
3. Divide the day's lesson into 5-6 segments.
4. Assign each student to learn one segment, making sure students have direct access only to their own segment.
5. Give students time to read over their segment at least twice and become familiar with it. There is no need for them to memorize it.
6. Form temporary "expert groups" by having one student from each jigsaw group join other students assigned to the same segment. Give students in these expert groups time to discuss the main points of their segment and to rehearse the presentations they will make to their jigsaw group.
7. Bring the students back into their jigsaw groups.
8. Ask each student to present her or his segment to the group. Encourage others in the group to ask questions for clarification.
9. Float from group to group, observing the process. If any group is having trouble (e.g. a member is dominating or disruptive), make an appropriate intervention. Eventually, it's best for the group leader to handle this task. Leaders can be trained by whispering an instruction on how to intervene, until the leader gets the hang of it.
10. At the end of the session, give a quiz on the material so that students quickly come to realise that these sessions are not just fun and games but really count.

Moreover, the jigsaw technique was first developed in the early 1970s by Elliott Aronson and his colleagues and students in the USA. It is a structured way of engaging every student by requiring them to cooperate with each other in order to master an area of knowledge. "The Jigsaw Classroom is a cooperative learning technique that reduces racial conflict among school children, promotes better learning, improves student motivation, and increases enjoyment of the learning experience" (Social Psychology Network, 2000-2017).

Above all, I internalized that for teachers whose native language is not English it is necessary to integrate English language instruction in mathematics teaching. In this regard, I confess that the CLIL approach improved the teaching and learning skills of mathematics of mine and the learning skills of my students as well.

Problem Solving or Reproducing Algorithms: Realizing Nonlinear Mathematics

"*What is problem solving*?" The Facilitator wrote on the board in the class of Mathematics Education. It could be any day of March 2007. I was in the class of "Math Education" during my master's study at KUSOED. The Facilitator asked all the students to write their views about it.

"*Problem solving is to solve a problem by using different techniques."*

"*It is a method of solving problems stepwise by using list of formulae*."

Almost all the students had the same perception about it. I still remember to some extent what perception I had about 'problem solving'. For me, it was like solving routine problems using various skills with the help of formulae. The Facilitator said, *"Is it problem solving or reproducing algorithms?"* I was surprised and could observe the same in others. The Facilitator said, *"In Nepal, most teachers have been following algorithmic problem solving method to solve the routine problems so as to find the previously known answers … and they think that they are teaching mathematics using the problem solving method …"*

From that grade, I realised that problem solving is not what I would think all about. I was merely teaching *algorithmic* problem solving method to solve routine problems by using various formulae, laws, rules, techniques and skills, and such problems had beforehand answers instead of general problem solving method. Feikes, Schwingendorf and Gregg (2014) asserted that 'general problem solving' is the practice of engaging students in working on challenging, non-routine problems (not necessarily word or story problems). They further coded that the intent of such general problem solving sessions is to help students develop a repertoire of problem-solving strategies, which are sometimes called heuristics. Since then, I came to realise that I was not a teacher but simply a trainer: training students to produce students as products using factory model of education. Nonetheless, as my master's study grew on, I gradually began to transform my mental model from linear thinking to nonlinear thinking so as to become a nonlinear teacher-practitioner.

Moreover, I began to realise that because of overuse of reductionist approach of teaching and learning of mathematics, I mostly promoted a linear teaching defined by a linear function $f(x) = ax + b$, where both domain and co-domain are defined in linear spaces, thereby producing the linear range of the function: I would think and act linearly to get the linear outcomes. Linearity almost became my universal characteristics, and cognition became my major instrument of thinking. In this regard, Bratianu and Vasilache (2009) defined that linear thinking is based on linear cause-effect relationships, which represent actually cognitive approximations of more complex relationships and processes (p. 5). I think I spent most time of my teaching in transmitting such linear cause-effect relationships to my students who learned to develop their procedural knowledge leading to conceptual knowledge. It means that I often taught mathematics on the basis of *procedures-first* theories, in which children first learn procedures for solving problems in a domain and later extract domain concepts from repeated experience solving the problems (Rittle-Johnson, Siegler, & Alibali, 2001; e.g. Fuson, 1988; Karmiloff-Smith, 1992; Siegler & Stern, 1998).

However, my master's study became a key basis to change my ways of thinking; more precisely, I must admit that I learned to think nonlinearly to develop nonlinear teaching and learning skills of mathematics for me and for my students. Henceforth, I began to practice *concepts-first* theories, in which children initially develop (or are born with) conceptual knowledge in a domain and then use this conceptual knowledge to generate and select procedures for solving problems in that domain (Rittle-Johnson, Siegler, & Alibali, 2001).

A major issue was raised in my heart and mind, "What is nonlinear thinking?" Initially, I took it as thinking 'out of the box' of linear thinking. But it was not an easy task for me to transform my ways of thinking and acting. I have to first transform myself to a real 'problem-solving teacher' from an 'algorithmic-problem-solving teacher', to a follower of concepts-first theory from that of procedures-first theory, to a transformative (e.g. constructivist) teacher from conventional (e.g. behaviourist) teacher or to a nonlinear teacher from a linear teacher. Whatsoever, I first considered mainly three aspects – cognitive domain, affective domain and nonlinear thinking to be integrated in my pedagogical practices to resist/reduce my reductionist approach of teaching. For this, I took the (revised) Bloom's taxonomy as a key reference and mingled all the three factors to produce a nonlinear teaching and learning of mathematics in the classroom. Not only cognition which refers to the mental process by which external or internal input is transformed, reduced, elaborated, stored, recovered and used (Neisser, 1967 as cited in Brandimonte, Bruno, & Collina, 2006, p. 3), I also gave emphasis on embodied cognition in which cognitive processes are deeply rooted in the body's interactions with the world (Wilson, 2002) so that I could use 'affective domain – beliefs, values, attitudes and emotions' (Grootenboer, & Marshman, 2016) to reduce my pedagogical ecotone and students' learning ecotone, thereby quitting corporal punishment as one of the instruments of enforcement of students' learning of mathematics. My ultimate approach of teaching was to reduce or resist reductionist pedagogy (but not to completely quit it) and introduce nonlinear teaching and learning of mathematics in the classroom.

Let me present an anecdote depicting what entails non/linear thinking while teaching and learning of mathematics in the classroom:

It could be February 2015 when the cold winter was at its best, but the sky was clear and the sun was pouring its calm and warm rays onto the earth. I entered the classroom of Grade 8 with teaching-learning materials to teach area of floor, ceiling and four-walls. In fact, I had already taken some preliminary classes and planned to do something different, which must be complex, unfamiliar and non-routine for my students.

"Today, we don't study. So, don't open your books."

Before I told my plan, all the students roared with happiness and began to clap. They were happy to hear the word "No study today!" However, I settled them down and told my plan.

"We don't open our book but do something different which you have never done before!"

They were too much curious to know what I was going to do next. According to my plan, I divided about 30 students into 5 groups with respect to gender, caste, ethnicity and academic performances.

"Go out of this classroom and find the vacant rooms in the school. Take the necessary measurements of the floor, walls, windows and doors with the help of the measuring tape and answer the following questions:

1. *Find the area of the floor, 4-walls and ceiling including doors and windows*
2. *Find the area of the area of the doors and windows*
3. *Find the area of the 4-walls excluding doors and windows*
4. *If the 4-walls and ceiling are to be painted, find the cost of painting at Rs. 500 per* m^2.
5. *If the 4-walls are to be decorated with designed papers, each of which is 25 cm by 25 cm, find the number of pieces of papers.*
6. *Find the cost of carpeting the floor at Rs. 300 per* m^2.

All the students engaged in their works. I observed their works and assisted whenever they had confusion. Time and again I reminded them to be aware about accuracy of their measurement. I also encouraged all the students to actively participate in the activities. After they accomplished their work, all of them came back to the grade. I asked them to share their experiences one by one. As soon as one student shared her story, the grade was over. I collected their papers

and left the classroom for the next day. The next day, I distributed their papers back. The students were already in their respective groups. I asked them to solve the questions. I observed their activities and assisted them whenever they needed. After they completed their assigned work, I collected their solutions and encouraged them to share their stories one by one. Not all, but some of them shared their experiences. I said, "How are you feeling now?"

"Awesome, Sir! We enjoyed a lot."

"We learned practically …"

"It was too messy to measure the doors and windows …"

"It was difficult to take the exact measurements …"

"It was funny when the number of papers was in decimal but while doing the textbook problems we never experienced such …"

"First we measured in foot system, later on we flipped the measuring tape and took the measurement once again in meter system. It was too messy …"

"I think I can take the measurement of my room in the house and calculate the cost of carpet …"

These were some of their experiences they shared in the classroom and this is how I broke the linear way of teaching and learning of mathematics in the classroom.

Next, regarding revised Bloom's taxonomy (Krathwohl, 2002; Eisner, 2000; Assalay, & Smadi, 2015), I came to realise that out of the six cognitive levels I hardly helped students exercise the first three levels *remembering, understanding* and *applying* whereas the other three *analysing, evaluating* and *creating* were almost not touched while teaching mathematics in the classroom, and henceforth I tried my best to practice all levels of Bloom's taxonomy. Most importantly, being in the process of transformation, I gradually practiced the developmental theories of Dewey, Piaget, Vygotsky, and Bruner that provided me the basis for the educational application of constructivism (Lutz, & Huitt, 2004) for the cognitive development of my students. Above all, most probably from 2009, I first began my career of educating teachers of the school where I was working by conducting workshops on Piaget's theory of cognitive development to mathematics instruction based on its principal that the development of a child occurs through a continuous transformation of thought processes according to age categories (Ojose, 2008).

According to Johnson and Johnson (1986), there is persuasive evidence that cooperative teams achieve at higher levels of thought and retain information longer than students who work quietly as individuals. More so, the shared learning gives students an opportunity to engage in discussion, take responsibility for their own learning, and thus become critical thinkers (Totten, Sills, Digby, & Russ, 1991). Therefore, I began to teach my students from 'out of the box' and encouraged them to link mathematics to their everyday activities through cooperative and collaborative learning of mathematics in the classroom. My students began to taste the flavour of not only the deductive method but also the inductive method of learning. Gradually, they began to practice the real-life situation problems escaping them from the routine problems, and hence they began to link academic mathematics to their day-to-day life activities and their cultural practices as possible as they could. Once, I designed a project work for Grade IX on "Contextualisation of Mathematics Education" and took the students to visit various workplaces and religious places. They studied, inquired and investigated mathematics out there in the field, took interviews of concerned people and prepared a report and submitted to me. I also encouraged colleague teachers in the school to design such projects and they did. Finally, I began to realise that after my tireless effort, students began to remember, understand, apply, analyze, evaluate and create knowledge to some extent because of their active participation in the classroom and practical works. I also noticed that my students began to improve their academic performances.

Since then, I began to exercise the ‘one-size-does-not-fit-all’ principle, thereby subordinating one-size-fits-all principle (Luitel, 2003, 2009), realising that every child is different. I began to build my rapport with my students by helping them connect their thinking to my own learning so as to understand their ways of thinking mathematically. Steadily, my students became like my friends because of my individual help and encouragement in their contextual mathematics learning. Gradually, both of me and my students began to develop the conceptual understanding and procedural skills as an iterative process of learning mathematics so as to improve their problem solving skills (Rittle-Johnson, Siegler, & Alibali, 2001). Before helping my students learn problem solving, I studied Polya’s (1945) problem solving techniques and began to implement them in my pedagogical practices. Moreover, in 1945, George Polya published his book “How To Solve It” with four basic principles of problem solving: Understand the problem, Devise a plan, Carryout the plan, and Look back (Pant, 2015). In due course, I gradually felt that Polya’s problem solving did help me and my students learn mathematics tactfully.

I understand that learning mathematics has become a necessity for an individual’s full development in today’s complex society (Ignacio, Blanco, & Barona, 2006). I was gradually becoming aware of technology integration in mathematics pedagogy because technological advances and the growing importance of the means of communication make it necessary for people to adapt to the new situations that are arising out of social change, thereby enhancing students in problem solving in a nonlinear way. Since I became a student of KUSOED in February, 2007, such awareness of ICT in mathematics teaching and learning came into my mind. It took long for me to accept ICT as a tool for mathematics teaching and learning. There could be many seen and unseen reasons behind why I was not confident in the use of

ICT, but one of them was my unpreparedness about ICT. Yes, I was ICT illiterate and it took long time to gain sound knowledge of ICT. However, since I began my MPhil study in February, 2014, I gained more knowledge about it through the courses by studying various research papers.

In course of gaining knowledge and skills about nonlinear teaching and learning of mathematics, I was too much fascinated by ICT pedagogy and its integration into classroom so as to break the rhythm and rhyming of my linear teaching. Luckily, on January-February , 2017, KUSOED organized six-days training for in-service mathematics teachers (K-12) led by a Full Bright Specialist, University of Great Falls, USA to Nepal from 11-4 pm, and I was the programme coordinator of 'Technology in Elementary Mathematics Teaching'. More so, recently, KUSOED also organized a national conference on "ICT Integrated Pedagogy for Effective and Meaningful Learning (8 July, 2017) under UNESCO Resource Distribution and Training Centre (RDTC), Kathmandu University School of Education (KUSOED) in collaboration with Ministry of Education (MoE), Nepal and Open and Distance Education Centre (ODEC) Tribhuvan University, Nepal, in which I presented my research paper entitled "The Role of ICT in STEAM Education: A Transformative Perspective" and conducted a mini-workshop session on "Prospects for Use of ICT in STEAM Education" with two fellow teachers. These show my growing interest in gaining knowledge and skills about ICT pedagogy. In turn, I have begun to enhance the use of ICT in teaching and learning in my school, not only for mathematics teachers but for all subject teachers. Most importantly, I have already begun to use ICT in the classroom through the available resources such as laptop, mobile, projector, etc.

However, despite acquiring many nonlinear pedagogical skills and techniques, I must admit that there were many challenges to fully implement them in the classroom: challenges such as resources like teaching-learning materials, time constraint, maximum number of students in the classroom, behavioural problems of students, heavy contents, math as a scoring subject, pressures from school and parents, work-load, low-paid salary, socio-cultural issues, etc. Out of them, I most frequently felt that major challenge for me was to make students to be able to score higher marks (grade) in the exams, thereby provoking me to enhance linear method of teaching and learning in the classroom with a motto “Fix a target and practice day and night to achieve it!” Because of this bitter reality, directly or indirectly I along with my colleague teachers would feel pressure from school and parents as after all, teacher’s performances were evaluated not by the principle what students learned but by the principle how better students scored in exams.

Above all, I don’t claim that I always taught mathematics using nonlinear methods; practically it was (is) not possible in the context of Nepal because of heavy course contents and its bi-products such as socioeconomic condition of school, exam-oriented culture, etc. Nevertheless, I admit that I became a transformative teacher, more precisely I would say, a teacher in transformation process and really began to realise the aesthetics of mathematics: the beauty of mathematics residing in and outside it, in the classroom and in students’ lifeworlds. More so, not only me, I was also able to transform my students’ ways of thinking and acting regarding learning of mathematics. Beginning my realization from the issues of ‘problem solving’, I could coagulate many nonlinear aspects of mathematics which my pedagogical sensitisation towards mathematics. However, I can’t claim that I didn’t have my sensitisation towards nonlinear aspects of mathematics teaching before I joined KUSOED; rather I would say I had acquired many of both linear and nonlinear aspects of teaching and learning of mathematics. However, those were yet to be felt, internalized, and implemented in the classroom, and I confess that it was a major challenge for me.

Where Do We Use Algebra? No Benefits in My Whole Life!

"Indra Sir, where do we use Algebra? I have never seen any benefits of learning Algebra in my school days."

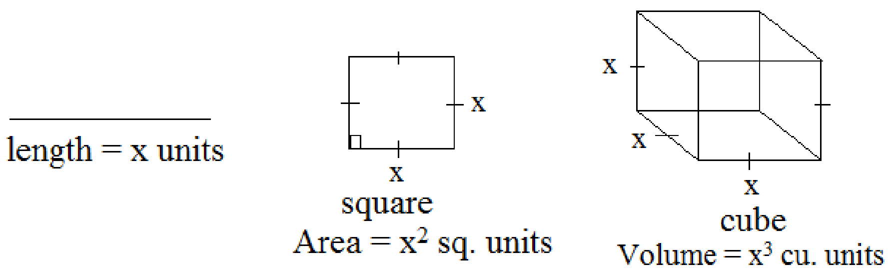
It could be June, 2014. The Managing Director of my school asked me a most popular issue of Algebra while I was discussing with teachers about how Algebra could be contextualized.

"Where do we use these algebraic formulae in our practical life, Sir?"

"Do these algebraic expressions and factorization have any application in our life, Sir?"

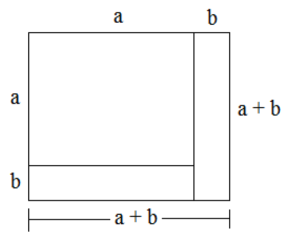
Based on my lived experiences, these are the prevalent issues being raised by students and common people as well in Nepal. I still remember that before joining MEd at KUSOED in 2007, I would convince my students that Algebra would help you in calculations, and you would know when you continue your Math study in college level. Later on, I came to realise that Algebra is all about generalization and help students in logical and relational thinking. How could I explain and prove practically that Algebra has application in our everyday life? In this regard, Barton and Katz (2007) proposed that initial algebraic thinking might best be developed through problem solving and geometry to enable more students to gain access to algebra (as cited in Booker, n.d.). How … how … and how? I was much thoughtful and it could be any day of May, 2015 when I was about to start Algebra in Grade IX in my school.

I sat on the bed in my room with paper and pencil. Began to think, think and think for long time. I lied down on the bed and kept on thinking. At that very moment, I came to realise that it was too difficult to get myself 'out of the box' of linear thinking and hence my unlearning process continued for a few time. However, there came a turning point when I began to think from the very basic Algebra, that is, a variable x. A one dimensional length can be measured as x units. My thinking grew on and expanded: two dimensional figures can be measured as x^2, that is, the area of the square, and three dimensional objects by x^3, giving the volume of a cube.

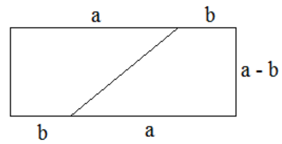


This is how a preliminary idea was generated in me with reference to the topic of factorization of algebraic expressions. However, there had been a challenge for me to contextualize the following basic algebraic formulae:

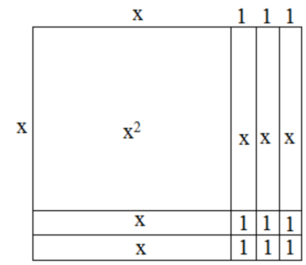
$(a + b)^2 = a^2 + 2ab + b^2$
$(a – b)^2 = a^2 – 2ab + b^2$
$(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3 = a^3 + b^3 + 3ab (a + b)$
$(a – b)^3 = a^3 – 3a^2b + 3ab^2 – b^3 = a^3 – b^3 – 3ab (a – b)$
$a^3 + b^3 = (a + b) (a^2 – ab + b^2) = (a + b)^3 – 3ab (a + b)$
$a^3 – b^3 = (a – b) (a^2 + ab + b^2) = (a – b)^3 + 3ab (a – b)$
$a^2 + b^2 = (a + b)^2 – 2ab = (a – b)^2 + 2ab$
$a^2 – b^2 = (a + b)(a – b)$



$(a + b)^2 = a^2 + 2ab + b^2$



$a^2 - b^2 = (a + b)(a - b)$



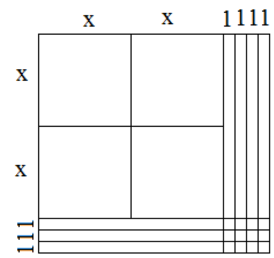
$x^2 + 5x + 6$

I prepared the models of the above formulae as well as some algebraic expressions of the type $ax^2 + bx + c$ (e.g. see the figures above). However, I heard from students what they would do in their practical life by just making such models. I interacted with them and tried to convince them that such models help them develop their algebraic thinking and reasoning using geometry. Nonetheless, for that, I had to think beyond and make some plans to explain how Algebra would be contextualized. In due course of unlearning, I came up with some contextual problems in which both algebra and geometry can be used. First, I discussed some contextual problems in the classroom and develop a project work for the students.

1. The length and breadth of a square land was decreased by 6 m and 4 m respectively. Represent the information geometrically and hence find the area of the new land.
2. One side of a square is increased by 7 cm and the other side is decreased by 9 cm so that the square takes a rectangular form. Represent the information geometrically and find the area of the rectangular land.
3. Each side of a square is doubled. Further, one side is increased by 2 cm and the other by 3 cm so that the new square takes a rectangular form. Represent the information geometrically and find the area of the rectangle.

4. The area of a rectangular plot of land is $(x^2 + 6x + 8)$ sq. inch. Represent it geometrically and hence find the length and breadth of the plot.
5. The area of a rectangle is $(2x^2 – 3x – 5)$ sq. m. Represent it geometrically and hence find the length and breadth of the rectangle.
6. A landlord had a square land. Upon the wish of his newly married wife, he changed his square land into a rectangular land. For this, he bought a piece of land from his neighbour so that the land increased by 3 m in length and 2 m in breadth. Represent the information geometrically and find the area of the new land.
7. A landlord had a square land. In course of widening the road, the Government of Nepal used 1 m of his land only on one side for the road. Represent the information geometrically and find how much area of the land is left with the landlord.
8. Dorje has got a square plot of land in a city which does not connect to the road. He wishes to open the paths on two adjacent sides, 3 m on one side and 2 m on the other. Represent the information geometrically and find the area of the land left with Dorje.
9. Dipak has got a square plot of land. He sells a square piece of the land to his close friend. Represent the information geometrically and find the length, breadth and area of the land left with Dipak.
10. A wealthy lady has got a square plot of land in a city. She bought some more pieces of land from her neighbours so that the land retained its square form while its each side was increased by the length of the original plot. She was still eager to buy some more pieces of land so as to change the square land into the rectangular form and hence bought some land so that the length and

breadth were increased by 4 m and 3 m respectively. Represent the information geometrically and find the area of the rectangular land. [Hint for Q. No. 10 is given in the figure alongside]



This is how I contextualized Algebra using geometry and was able to convince my students. More so, I had also a challenge to explain to the school teachers that Algebra is basically about relation between two quantities (e.g. numbers), thereby leading students to building up the ability of algebraic reasoning and generalization.

Therefore, my next responsibility as a teacher educator was to educate the school teachers of my school. To address the concern of the Managing Director of the school, I prepared one day "Interactive Workshop" for the teachers in the school recently on July, 2017. There were about 15 mathematics teachers from primary to secondary level (Grade 1-10). First, I divided them into four groups so that at least one teacher from each level falls in each group. The topic of the workshop was "Algebraic Reasoning" with an objective of providing teachers with 'early algebraic sense'. In fact, I had a plan of giving workshop not to teach them how students solve algebraic equations with x and y; rather my intent was to help them understand the underlying concepts of algebra. That's why; I was eager to interact with them and encourage them to interact to each other too in the workshop as I had observed many times that they rarely shared their ideas with the colleague teachers. More so, based on my experience I have observed that most teachers in Nepal think that Algebra is simply about manipulations of symbols representing constants and variables by using laws, principles and formulae. However, upon interaction and from the observation of teachers' classes, I have found that most teachers have no/less idea about "conceptual algebra readiness that lays a foundation for children to make sense of algebra rather than to manipulate symbols mindlessly" (Feikes, Schwingendorf, & Gregg, 2014).

The whole workshop was focused on the issue that Algebra is basically about establishing relation among numbers, thereby giving rise to generalization with the help of symbolic representation. In this regard, Mason (1996) stated that the teaching of early algebra is synonymous with generalized arithmetic, while "generalizations should be built from arithmetic and quantitative reasoning" (Smith & Thompson, 2008). More so, Feikes, Schwingendorf, and Gregg (2014) asserted that algebraic reasoning is simultaneously two key concepts: *generalization* and *symbolic representation*. The heart of algebra is generalization (Kaput, 2008; Mason 2008) but one cannot generalize without symbols to represent the generalization (Kaput, Blanton, Moreno, 2008). The two go hand in hand.

I accomplished the workshop having wide interactive discourses with the help of many illustrative examples, some of which I have listed below:

Algebra is about establishing relation: Early grade children can develop the sense of relation between numbers using signs and symbols: For examples,

First phase: $2 + 3 = (\ldots)$; $5 - 3 = (\ldots)$; $4 \times 3 = (\ldots)$; $6 \div 2 = (\ldots)$

Implications: Children will learn how four basic operations work on the basis of sign and symbols. For example, the sign '+' relates 2 with 3 to get 5 with an assumption that 2 is increased by 3 to get bigger sum 5. Similarly, the sign '–' relates 5 with 3 to get the difference 2 with an assumption that 5 is decreased by 3 to get 2; the sign '×' relates 4 with 3 to get the product 12; and the sign '÷' relates 6 with 2 to get the quotient 3. This type of simple relation is the basic foundation for algebraic generalization such as $2 + 3 = x$; $5 - 3 = y$. In due course of learning, children learn to generalize that the sign '+' operates on two or more numbers so as to give a new number which is greater than the two numbers. However, a teacher should also be clever enough to give a counter example in which this assumption fails. For example, $2 + 0 = 2$, which is greater than 0 but equal to 2. Similarly, the sign '–' operates on two or more numbers so as to give a new number which is less than the original number from which a number was subtracted.

Second phase: $(\ldots) + 3 = 7$; $(\ldots) - 2 = 1$; $7 + (\ldots) = 12$; $9 - (\ldots) = 4$

Implications: Children will learn what should be added to or subtracted from to get the given result. In such cases, they develop the knowledge and skills about how the given numbers relate to each other on the basis of signs '+' and '–'. This type of simple relation is basic foundation for algebraic generalization such as $x + 3 = 7$; $y - 2 = 1$; $7 + p = 12$; $9 - m = 4$. In due course of learning, children will develop skills that x, 3 and 7 are so related that 3 should be subtracted from 7 to get the value of x. Similarly, to get the value of y, 2 should be added to 1; to get the value of p, 7 should be subtracted from 12; and to get the value of m, 4 should be subtracted from 9.

Third phase: $(\ldots) \times 2 = 10$, $5 \times (\ldots) = 15$; $8 \div (\ldots) = 4$; $(\ldots) \div 6 = 2$

Implications: Children will learn what should be multiplied by or divided by to get the given result. In such cases, they develop the knowledge and skills about how the given numbers relate to each other on the basis of the signs '×' and '÷'. This type of simple relation is basic foundation for algebraic generalization such as $x \times 2 = 10$, $5 \times y = 15$; $8 \div a = 4$; $b \div 6 = 2$. In due course of learning, children will develop skills that x, 2 and 10 are so related that 10 should be divided by 2 to get the value of x; 15 should be divided by 5 to get the value of y; 8 should be divided by 4 to get the value of a; and 6 should be multiplied by 2 to get the value of b.

At the end of the above activity in the workshop, I suggested teachers to develop the related activities to boost the mental math of students, some of them are listed below:

Activity 1: What should be added to 3 to get 5?

Implications: Children will learn to calculate mentally that $5 - 3 = 2$.

Activity 2: What should be subtracted from 6 to get 2?

Implications: Children will learn to calculate mentally that $6 - 2 = 4$.

Activity 3: By what should 6 be multiplied to get 12?

Implications: Children will learn to calculate mentally that $12 \div 6 = 2$.

Activity 4: By what should 8 be divided to get 4?

Implications: Children will learn to calculate mentally that $8 \div 4 = 2$.

It is clear from the above illustrative examples and activities that arithmetic deals with specific numbers that are known and algebra deals with variables and the unknown. Therefore, moving from arithmetic to algebra is like going from the known to the unknown (Bednarz, Kireran, & Lee, 1996). Moreover, based on my experience, I found that after repeated use of above problems, children would be able to develop algebraic thinking and reasoning.

Algebra is about generalization and symbolic representation: Feikes, Schwingendorf, and Gregg (2014) stated that children begin thinking symbolically early in their development. For example, in play children represent one object for another such as pretending that a block of wood is a car. Similarly, in algebra a letter may stand for a number. Both of these activities are relational and representational activities. However, the concept of variable is a complex one, and it is important to note that a variable is more than a letter used in place of a number or a place holder. To address complex nature of the concept of variable, I discussed some activities with the teachers, some of which are listed below:

Activity 1: “What’s My Rule?” which I extracted from Feikes, Schwingendorf, and Gregg (2014) and illustrated in the context of Nepali school applicable for fifth and sixth grades.

Tell children you are thinking of a rule and that when you apply the rule to the first number you get the second number. Write at least two pairs of numbers that fit the rule on the whiteboard. Ask the children to give you two other numbers that they think may fit the rule and record the solution on the whiteboard. You may give a hint that children may use any of the four arithmetic operations i.e. +, –, × or ÷. Link it to the above activities done in establishing relation among numbers. You may first illustrate it to the children with an example such as think two pairs of numbers (2, 5) and (6, 9). Here, my rule will be ‘add 3’and its symbolic representation would be ‘+ 3’. This is the basic foundation for the general rule ‘x + 3’ of Algebra in which the unknown ‘x’ represents a variable, because children can give any value to x to get a pair of numbers satisfying the rule ‘+3’. Now, ask children to produce at least five pairs of numbers using the rule ‘+3’.

Similarly, you can develop the other rules of subtraction, multiplication and division for fourth and fifth grades. After this, such basic algebraic thinking and reasoning can be further extended for children of upper grades to the following “What’s My Rule?” For example, ‘double the number and add 1’. For this, tell children to think a number, tell them to double it and finally to add 1 like think the number 4 which when doubled becomes 8, and finally when 1 is added to it, it becomes 9. Tell them to represent symbolically. If they can’t, write yourself such as 2 × 4 + 1. Tell them to write at least five examples using the same rule. For example, *2 × 4 + 1*

2 × 3 + 1

2 × 5 + 1

2 × 1 + 1

2 × 6 + 1

Tell children to tabulate them and write the symbolically.

Think a number	*Arithmetic Rule*	*Algebraic Rule*
4	*2 × 4 + 1*	*2x + 1*
3	*2 × 3 + 1*	
5	*2 × 5 + 1*	
1	*2 × 1 + 1*	
6	*2 × 6 + 1*	

Similarly, you can encourage students to practice for 2x + 2, 2x + 3, etc. More so, you can now switch this practice to 2x – 1, 2x – 2, 2x – 3, etc.

In the above activity, when children are thinking a number, they are doing arithmetic. However, when they have the rule in their head and express it in written words or in symbolic notation, they are doing algebra.

……◦……

It could be any day of May, 2014. I had a plan of teaching "Solving Simultaneous Linear Equations Using Graph". Before starting the lesson, I asked a question to the students of Grade VIII: You must have an idea of drawing points on graph! Can you find some points of the straight line x + y = 5? They engaged in finding the points while I kept my eyes on their activities moving students to students. I found only a few students who could find hardly three points, while others were just waiting for my response without having any attempt from their side. Moreover, the students used the famous algorithmic problem solving method like shifting one of x and y to the right and substituting vales for them such as $x = 5 – y$ or $y = 5 – x$. Immediately, I posed a question, “Can you calculate the values mentally?” The grade was silent. Only a boy and a girl raised their hands and others were quiet. In the mean time, I changed my plan and began to teach how one can calculate the values mentally: I suggested them to begin with 0 and go ahead.

If $x = 0$, how much should be added to 0 to get 5? They told 5. So, $(x, y) = (0, 5)$. After that, as soon as I asked “If $x = 1$, then y equals what?” they told it was 4. Finally, they were able to calculate the pairs of numbers such as (0, 5), (1, 4), (2, 3), (3, 2), (4, 1), (5, 0).

I remember now how happy they were when all of them were able to find out the values. However, their happiness was yet to go off very shortly, because I was going to deal with negative numbers. I asked them, “If $x = – 1$, what would be the value of y?” They began to whisper to each other while a few smart students just began to calculate mentally and a few used pen and paper. I intercepted immediately when then took time and said, “It’s 6.” Next, I encouraged to try from their side and said, “If $x = – 2$, then y equals what?” Most of them told it was 7. Finally, they were able to find out the pairs of numbers such as (–1, 6), (–2, 7), (–3, 8), (–4, 9), and so on. Immediately, a boy raised a question, “Sir, can’t we use decimal number?” I replied that we can use decimal number too and I illustrated with a few examples. However, I made them aware about what sorts of pairs of numbers should be chosen to plot them in graph. In fact, to plot the graph manually students must be selective and have to choose numbers which are not too big and decimal numbers as well.

A girl said, “Sir, may we do it like that, umm … I mean, mentally in the exam?” I had expected such question from them or if they had not asked, I would have told them at the end of the grade. I said, “In Nepal, No … I mean, you can’t do it that way … you have to show all the steps of calculations …” In this regard, I confess that I was bound by a fear that students wouldn’t get full marks if they didn’t show the necessary procedures in the examination. More so, I had to prepare my students for the District Level Examination to be conducted by the Board of Exam and the answer sheets would be checked by unknown teachers. *Moreover, I have a wearisome experience that there are still many teachers who reduce marks if the steps are escaped while solving the problems, and hence I fear if my students will be victimized.*

Further, I gave another equation x – y = 3 and asked them to find out some pairs. Though they took much time than before, they were able to do it. Nonetheless, it was a tough gulp for them when I gave 2x + 3y = 6. The classroom became noisy enough and I had to intercept them. I said, “If you calculate it mentally, it will take long time. Therefore, I suggest you to express one of x and y in terms of the other like $y = \frac{6-2x}{3}$.” After that, I taught them the procedures and found only three pairs of x and y, which are sufficient to draw a straight line. In the next classes, I taught them to plot the graph of straight lines and find their point of intersection.

Moreover, I presented this anecdote to portray how a teacher can help students realise that algebra can also be connected to coordinate geometry so as to reply them to their common question “Where do we use Algebra in our life-world?” However, it was still difficult for me to convince them how our everyday problems are transformed into algebra and coordinate geometry and solved easily. In this regard, one day while teaching coordinate geometry I brought a contextual example into the classroom. “Suppose you are at this school right now. The last bell rings and you are ready to go back home on foot. First, you walk 1 km towards North and reach Koteshwor. From there, you turn to the west, walk 2 km ahead and reach home. Now, sketch it on graph, write the coordinates of the school, Koteshwor and home, and find the shortest distance from school to your home." They were stunned by the question. They even could not attempt it; rather I had to explain it on the board: You begin you journey to you home from the school. So, take it as origin and draw the X- and Y-axes. Here, the coordinates of the school are S(0, 0). Now, you walk 1 km to the North to reach Koteshwor; so its coordinates are K(0, 1). From Koteshwor, you turned to the West and reach your home. So, the coordinates of your home are H(– 2, 1). Now use distance formula to find out the shortest distance between the school S(0, 0) and your home H(– 2, 1):

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2} = \sqrt{(-2-0)^2 + (1-0)^2} = \sqrt{5}\text{ km}$$

I engaged the students in solving such contextual problems while teaching the lessons of distance formula and section formula. At the end of the lessons, I assigned them a project work and the questions look as follows:

Q. No. 1) Suppose that you are at Laligurans Batika School right now. You start your journey and go straight to the North walking 1 km to reach Koteshwor. After that, you turn to the West and walk 2 km to reach your aunt house. There, you take 1 hour rest and walk 3km straight to the South and reach your home. On the basis of the above information, answer the following questions:

i. Draw the above information on graph paper by taking the School at the origin O, Koteshwor at K, aunt house at A and your home at H.
ii. Write the coordinates of all the points O, K, A and H.
iii. Find the shortest distance between the school and your home.

iv. Join the points K and H and find the ratio in which the X-axis divides the line segment KH. Also find the point of intersection of the line segment KH and X-axis.

v. Join the points O and H. Find the coordinates of the middle point that lies between the school and your home. Locate the middle point on the graph.

Q. No. 2) A person standing at a place situated at point A(– 3, 9) has to walk along a straight road to reach the place situated at point B(6, – 6). But instead of walking the whole distance, the person jumps three times by covering equal distances each time to reach the point B. What are the coordinates of the two points in between A and B? Draw the above information on graph.

Above all, being a transformative teacher I have become much aware about algebraic thinking and reasoning which, in turn, has been helping my students improve their ability of algebraic reasoning, so far. My students have, at least, broadened their horizon of thinking, and have become imaginative and creative to some extent than ever. Even, the school teachers are pretty aware about algebraic thinking and reasoning. Though it takes time to implement such in the school in an effective manner, I am happy that my small effort helped teachers and students realise the application of Algebra in the practical life-world.

Touching the Untouchables: Paving the Nonlinear Path

"What's your problem, dear? Tell me openly so that I can help you."

"Sir, I can't digest mathematics. It never goes into my mind. It's out of the world."

This is the conversation between me and a very weak-in-math student of Grade IX. It could be any day of May, 2014. The school had instructed me to take the remedial classes of weak-in-math students. There were

11 students altogether. According to my plan, I didn't teach any content in the first day rather I had a wide interaction with them. Based on my experience, I had an assumption that one of the many reasons why students didn't like mathematics could be a distance maintained between teacher and students. I have heard from colleague teachers and the Principal, "A teacher should maintain a distance with students. Otherwise, students don't obey the teacher, and it will be very difficult for teachers to teach them effectively." However, I had a different view that a teacher should build a good rapport with students so as to gain their positive attitude towards teachers. With this assumption, I dealt with those 11 students and interacted one by one in the classroom. They had many hidden and untold stories deep seated into their mind and heart, which I wanted to be unfolded though it was a tough task.

"My dear students, you must realise why this extra grade is run early in the morning ... My ways of teaching mathematics is different … Unless you openly put your views towards mathematics, no one will be able to help you learn mathematics … Indre ko baau Chandre aayepani kehi garna sakdaina[11] *… So, I am here to help you … You are my special students … I am given a responsibility of uplifting your level of mathematics learning … Please share your problems with me here in the classroom or if you feel uncomfortable here, you can meet me personally and share your problems … let me see what I can do for you … Believe me that I won't disclose your problems to anyone; it's my firm promise to you …"*

The first day of the class was spent in understanding their problems. From the first interaction, I could collect their first information about their problems related to mathematics, mathematics teachers and mathematics learning. They did not openly share their bitter part of experiences of mathematics learning. Moreover, I was trying

[11] Trans: Neither Indre nor his father Chandre can do anything, meaning that nobody can help them.

to read and win the heart and mind by touching the untouchables of my students. In fact, I was trying to deal with their affective domain, especially their beliefs, values, attitudes, and emotions towards mathematics and mathematics teaching and learning (Grootenboer, & Marshman, 2016). Only the first encounter with students was much less than sufficient in understanding them; rather I needed a prolonged engagement with students to dig out their deep-rooted affects towards mathematics, and henceforth I put all my effort to extract their stories as possible as I could. In this regard, I listed four issues of mathematics teaching and learning based on beliefs, values, attitudes, and emotions and started my inquiry ahead.

In the second day, I again continued my interaction with the students instead of directly entering into the content teaching. After spending half of a one hourgrade in interaction, I began to teach the contents from the very basics based on their first information. Upon interaction many hidden stories of the students came to the surface. More so, I kept on interacting with them the whole academic year in the classroom, corridors, canteen, ground and Facebook, etc., wherever and whenever I met them personally. In the same way, I also interacted with other students of the school formally/informally about the affective domain of mathematics and mathematics teaching and learning. More or less I interacted with more than 50 students the whole academic year. I also requested students to write in a paper and submit their stories and they did. In between, I also took the perception of all mathematics teachers of the school what they would think all about mathematics, mathematics teaching and learning. I kept records of all of their anecdotes and stories and produced journals at home. Based on their narratives and my previous experience, I interpreted my data on the basis of researched based literatures. Here, I present categorically the beliefs, attitude, values and emotion towards mathematics and mathematics teaching and learning.

When I asked a question about their beliefs about mathematics to know about the nature of mathematics like “What do you think mathematics is all about?” Nevertheless, during interaction I explain what I intended to know from them such as ‘Is mathematics easy or difficult?’, ‘Is mathematics helping you in your day to day life?’, ‘Will mathematics be useful in your journey of life in future?’, ‘What do you think you will do in future after learning mathematics now in school?’, ‘How do you learn mathematics at home?’, etc. Here are what they had to say:

“Mathematics is very hard to understand.”

“I don’t know why we have been studying the same thing repeatedly in mathematics since the time we joined school!”

“It is very hard to learn the formulae and procedures.”

“Many of mathematics are useless … they have no use in our life in future.”

“Some parts of mathematics help us in calculations of area, volume, percentage, profit and loss, marked price and discount, commission and taxation, interest of sum of money, etc., but what to do studying geometry and algebra?

“Its good aspect is that it helps us to increase percentage in exams while its bad aspect is that it increases tension.”

“Mathematics is for those who want to become an engineer or a pilot.”

“Mathematics is about doing much but scoring less in exam.”

When I categorized their views, I came to realise that they viewed mathematics mostly from three perspectives: mechanistic (instrumental), Platonist, and problem-solving. In this regard, Ernest (1991) stated three conceptions of mathematics: (1) mathematics as an expanding field of human invention which is dynamic and problem-driven (Problem-solving view); (2) a structured, unchanging body of knowledge (Platonist view); and (3) mathematics as a collection of procedures, facts and skills (Instrumentalist view).

From their narratives, I came to realise that most common perception among students was instrumental, in that mathematics was about (rote) learning of heavy content by practice method using various formulae and procedures. Most students still had a traditional belief about mathematics reflecting the Platonist viewpoint, which views mathematics as a unified body of knowledge with an ontological certainty and an infallible underlying structure (Sriraman & English, 2010), and which deals with cognition, the mind processing and told that only brainy students can do mathematics. Some students think that it is pure, universal, objective, certain and unchangeable (e.g. Luitel, 2009; Hersh 1985; Lerman, 1986, 1990; Ernest, 1991, 1994). A few had their views that mathematics was impure, *wabi-sabi*, subjective, corrigible, revisable, and changeable (e.g. Luitel, 2009; Maheux, 2016; Ernest, 1991, 1994). A few also raised the issues why they study foreign mathematics but not the local mathematics such as informal, artefactual, communal, ethnic and indigenous practiced by the people in their everyday life (Luitel, 2013).

Finally, I came to realise that among the most of the students and teachers, there was a perception that mathematics is famous for its abstractness, absoluteness, universality, calculation, thereby supporting the instrumentalist and Platonist viewpoints, while a few had an idea about its dynamism and practical use in their everyday activities. It suggests that the school mathematics in Nepal is neither inclusive nor empowering to some extent. Moreover, it was very important for me as a transformative teacher to know and understand students' belief about mathematics because I believe that they influence the nature of learning in the classroom and the way they engage with the mathematical materials of their lessons (McDonough, & Sullivan 2014). More so, it also encouraged me to help my students change their beliefs about mathematics from the Platonist and instrumental viewpoints to mathematics as an expanding field of human invention which is dynamic and problem-driven.

The next issue that I raised was about value of mathematics and mathematics teaching and learning. In this regard, I asked a question, "What are the values of mathematics?" However, during the interaction, I found that most students were not clear about the fact that "Education is value-laden" (Bishop 2000; Seah & Barkatsas, 2014) and hence mathematics is also value-laden. Ernest (1996) urged that mathematics education should be humanized so that mathematical knowledge is to be invented but not discovered. Orienting to this issue, I time and again elaborated the issue during the interaction to make it clear to the students such as 'Do you think you have any advantage of learning mathematics?', 'What will you get after learning mathematics?', 'Any benefits of learning mathematics now and in future?', 'What changes do you see in your life after learning mathematics since childhood?', etc. I knew that value is about 'worth something', which has a great influence in students' mathematics learning. Unless students are aware about the values of mathematics, they won't entertain learning and doing mathematics. Here are what they had to say:

"Ah! For me … umm, no any benefit of learning mathematics … Because of it, I always get into problems … I was scolded and punished by my teachers and parents many times … It has become a burden for me …"

"Huh! So funny question, Sir! It's simple … it has helped me score marks in exam …"

"Oh! Yeah, mathematics has great values in my life. Without mathematics nothing is possible in this world. It is everywhere in our practical life. It is the basic foundation of all subjects."

"Mathematics has helped me in scoring higher percentage."

"What to do by learning mathematics in school, Sir! It does not teach us practical aspects. Last time, my father asked me to measure the room so as to buy carpet. So funny, I couldn't …"

"My aim of life is to become an engineer. So, mathematics has great values for me."

After digging out their anecdotes and narratives and my experience, I came to realise that most students did not have what benefits they had from mathematics. Most of them thought that mathematics is a scoring subject in exams and is learned by those who want to become engineer in future. It means that students have a negative perception about the value of mathematics than its empowering attribute. I think that the heavy contents and overuse of procedures and formulae have not allowed students to think creatively so that they cannot realise the value of mathematics learning in the classroom despite having many immediate and future advantages of mathematics learning in school. Nonetheless, some students who were good at mathematics thought that mathematics has its practical application in their life and they were also aware about its application in their future study.

In course of interaction, I also inquired about their attitudes towards mathematics. Based on various literatures, I came to realise that attitudes are defined as "affective responses that involve positive or negative feelings of moderate intensity and reasonable stability" (McLeod 1992, p. 581). Therefore, I made up my mind to inquire both positive and negative feelings of students towards mathematics. More so, I also studied attitudes as "manners of acting, feeling, or thinking that show one's disposition or opinion" (Philipp, 2007, p. 59). In this regard, I asked a common issue, "What is your attitude towards mathematics?" To simplify it to them, I divided this issue into some subsidiary issues such as 'Do you have positive or negative feeling about mathematics?', 'What happens with you when math teacher comes in your classroom?', 'How do you behave with math teachers?' 'Have you ever felt discouraged when you failed or scored poor marks in mathematics?', 'Did you ever feel encouraged after you scored good marks in exams?', etc. In their response, here are what they had to say:

"I have a positive attitude towards mathematics learning. It's my favourite subject."

"I have a negative attitude towards mathematics learning. It's the most unaccepted subject."

"I hate mathematics and will never learn it after Grade X …"

"I will throw all mathematics books into dustbin after Grade X …"

"Once in Grade three I failed in mathematics. Since then I have never passed mathematics up till now in Grade X."

"I would fail in Mathematics up to grade 5. When a new teacher came to our school in grade 6, since then I improved in mathematics learning. Now, I score at least pass marks in the exams."

I also inquire about the factors influencing students' mathematics learning. Therefore, during interaction I asked the questions like 'Which subject teacher do you like the most?', 'Do you understand nicely while your teacher is teaching mathematics in the classroom?', 'Do you ever try to change your previous negative attitude towards mathematics, and did anybody help you in this regard?' Here are what they had to say:

"My favourite teachers are many but not the mathematics teachers, because mathematics teachers are very strict in the classroom. But I like you, Sir (smiles) …"

"My favorite teacher is mathematics teacher."

"I never understand what the mathematics teacher teaches in the classroom. I just copy what he writes on the whiteboard."

"I could never change my negative perception towards mathematics. But I want to change it."

"Mathematics teachers are very dangerous. They always stick on the board, do calculations and asked us to do in the classroom. If we can't do it, they often scold us …"

"I always afraid of mathematics teachers and can't ask anything in the classroom."

"Most mathematics teachers are not helpful. They just shout at us and order us to practice the problems."

"Mathematics teachers are famous for giving more homeworks than others. They are not supportive."

"I am always helped by my math teachers in my whole life up till now."

"There was a math teacher who helped me improve mathematics. He was too supportive."

Based on these anecdotes and my experience, I realised that there are five factors that influence in developing attitudes towards mathematics and they are: teacher characteristics; teaching characteristics; classroom characteristics; assessments and achievement; and, individual perceptions and characteristics (Goodykoontz, 2008). Out of which, the most influencing factor was the teacher characteristics. The other one was the assessments and achievement which either demoted or promoted students' mathematics learning depending upon the positive or negative attitude towards mathematics teacher respectively.

The last and most significant issue that I inquired with the students was emotions towards mathematics. When I asked a very common question, "Do you like mathematics?" Here are what they had to say:

"The only subject I dislike is mathematics because it has got no fun."

"No stories, no connectivity with real life. Only proving theorems, calculating values, simplifying big-big algebraic expressions and fractions, solving difficult verbal problems …"

"Learning mathematics is like walking on the desert; it's very hot and hard …"

"Mathematics teachers have no soul; they don't respect our feelings. All they want from us is 'learn, learn and learn only mathematics'. Aren't there other subjects?"

"There are a few mathematics teachers who understand our problems, respect our feelings and help us all the way in learning."

Moreover, I inquired the students' emotional responses to mathematics, particularly their happiness and anxiety so that it would help me understand students' emotional attachment towards mathematics so as to enhance a meaningful learning in the classroom. In this regard, Grootenboer and Marshman (2016) stated that the students' emotional responses to mathematics include joy and excitement, but more commonly expressed feelings are panic, boredom and frustration." More or less, I got the same result from the interaction. Moreover, most students disliked mathematics and had negative emotions towards mathematics. They thought that they studied mathematics because it was compulsory in school, and their parents pressurized them all the time. This is also supported by the cases in the USA where two-thirds of Americans either loathe or hate mathematics (Furner, 2000, 2004).

Above all, taking beliefs, values, attitudes and emotions as the fundamental factors of affective domain, my study showed that most of the students have negative perception towards mathematics, thereby resisting students' mathematics learning in the classroom. The main objective of finding out the perception of students about affective domain was to know whether affective domain had role in motivating students towards mathematics learning or not. After the result in my hand, I came to realise that being a transformative teacher I should transform myself to a teacher with full of emotions. To my surprise, the School Leaving Certificate (SLC)/Secondary Education Examination (SEE) results in the last three years were better than before. The Principal of the school often says to me whenever discussion goes on regarding SLC examinations, *"IM Sir, your miracle guidance helped our students achieve better results in SLC and SEE because of the better marks obtained in mathematics."* However, I must admit that every year a few students were there who couldn't do as much as I expected despite my efforts.

Referring to the initial anecdote of grade IX students, I dealt with students individually in and out of the classroom. Based on individual's problems, I worked hard to uplift their individual performance in mathematics. I used every possible method to build up their 'positive attitude' towards mathematics. For example, one day recently in the last week of July 2017, I scolded a girl of grade IX in the classroom while I was teaching mathematics. It was because she never concentrated in learning, never listened to the teacher, and never did problems in the classroom whenever I suggested the students to learn through cooperative learning; instead, she often began to gossip with friends. I observed her faded facial expression with some attributes of temperament; she was really very unhappy to have scolded in the classroom. Since then, I noticed her activities in the classroom: she was quiet, had no interaction with friends, no question to me, even she did not speak to me for two days.

However, I immediately realised that I should talk to her personally and I did it. From her conversation, I came to know that her mother married with another married man, both of whom had lost their partners. Now, her new father had not yet registered her name in the municipality while she urgently needed birth certificate to fill the SEE exam form. I consoled her and assured that I would help her in that case but also convinced her to improve her performance in mathematics. Since then, she became my friend, and often gives me a piece of fruits while teaching mathematics in the classroom. Miraculously, she could obtain 17 out of 50 in the mid-term test held recently in August, and it was her best performance in mathematics than ever. I praised her in the classroom while distributing the checked answer sheet and observed very closely the smiles on her face.

In the other event, a new student who was admitted to the school in Grade IX always had good interaction in the classroom but just scored more or less 40 of 100 in mathematics in the first terminal exam. I was too much surprised from his underperformance in mathematics. Fortunately, his mother sent me a friend's request on Facebook with a message about her son's underperformance in math. During conversation via Facebook, I came to know that she stayed alone at Delhi, India as workplace while his son and daughter stayed with their grand-parents in Kathmandu, Nepal for their study. She said, "Sir, I am single … I admitted my son and daughter in your school this year … My son couldn't do well in math exam … Please, give some special attention to him … Simply for my children, I am far away from them … Please, do not unfold that I am single and all about my family tension in the school;

otherwise my son may feel … You understand what I mean to say …" I was too emotional for the student.

From the very next day, I began to observe him in the classroom without letting him know that I had a conversation with his mother. After about a week when I gave a unit test of geometry theorems, he again could not score as expected. Within a couple of days, luckily I saw him alone in the classroom just before the school assembly. I immediately approached him and urged that I wanted to talk to him about his poor performance in math. I called him out of the grade and took to a corner of the school ground. I inquired why he was not able to score better marks in both first term exam and unit test. I talked to him for about half an hour and dug out his stories. He said, "I understand very well in the classroom, Sir. But … my grandmother is of grumbling nature … her dos and don'ts always make me irritate … I have no supportive environment at home … That's why; I don't like to study …" I said to him as if I knew nothing about his family, "What about your parents!" He was first awkward and said, "They are not here …" I immediately changed the topic and counseled him. However, some days later, I again talked to him that I was a Facebook friend of his mother and told him that I knew about his family. I said, "Your mother told me all about your family. But don't worry I wouldn't spill it out … I suggest you to face the challenges as life is full of happiness and sorrow … If you are able to do your best in education, you don't have to depend on others … Become a brave boy and put your all effort in study leaving behind all such family tensions …" Since then, he was in my notice and I could observe some changes in his behaviours in terms of mathematics learning.

Above all, being a transformative teacher-researcher, I have started practicing the affective domain in teaching and learning of mathematics, so far. It has broadened my horizon of thinking and acting in my pedagogical practices. Moreover, I would think in a linear way that teaching is just like transmitting knowledge and skills to my students as if both teaching and learning are linear in nature. Maybe, by nature I practiced nonlinearly, but I was unknown about the nonlinearity in teaching and learning of mathematics. Indirectly or unknowingly, I was following 'banking pedagogy' (Freire, 1993) and enforcing my students to use their cognition, thereby neglecting or subordinating affective domain of mine and students as well. However, I confess that I have broken my unique linear pedagogical practices, so far.

Look into Yourself: Becoming a Critical Reflective Teacher

"What is good teaching?"

A thousand pound question was posed by the Professor in my MPhil class. It could be any day of January 2014 when it was just one month passed since I started my journey of MPhil study. All of us wrote a few sentences and shared in the classroom.

"Good teaching is about facilitating students for meaningful learning."

"Good teaching is not only about teaching contents rather it is also about giving conceptual understanding."

"To have good teaching, a teacher should have strong content knowledge and skills to convey that knowledge to students."

During interaction, the Professor said, "Look into yourself! You are missing an important point." We began to think what was missing and hence discussed each other, but no one of us could tell what he expected. Later on, he gave us a hint and said, “It begins with R”. We tried but no one could tell anything about the full form of R. The Professor told that it was ‘Reflective Teaching’.

Since then, I began to recall my past memories when I was master’s student. Yes, I had already learned about ‘reflective teaching and learning of mathematics’ during master’s course and henceforth I could accomplish my master’s dissertation in 2011 (Shrestha, 2011) entitled “*My Journey of Learning and Teaching: A Trans/formation from Culturally Decontextualised to Culturally Contextualised Mathematics Education*” based on ethnomathematics (e.g. D’Ambrosio, 1978, 1985, 1990, 1998, 2006) using auto/ethnography as research methodology. Moreover, becoming a reflective learner, teacher, educator and researcher was completely new but wonderful experience for me. After becoming a reflective learner throughout my master’s study, I gradually enhanced it in my teaching, which helped me become a ‘critical’ teacher. Through various literatures, I came to realise that being critical is not synonymous with being negative; rather critical teacher/educator are committed to democratic principles of equity and justice. Later on, I came to know that being critical is liberating, enlightening, emancipating, and empowering through various literatures. In this regard, I also became aware of three domains of critical mathematics education – ethnomathematics, equity in mathematics education and culturally responsive teaching with the goal of empowering students with knowledge, skills and dispositions needed to create democratic communities embracing social justice in and outside of school (Tutak, Bondy, & Adams, 2011).

Among the contributions of Giroux (1983), Foucault (1986), Dewey (1897, 1910, 15, 16, 33, 34), Freire (1970), Kincheloe (2008), McLaren (1999) and others, Freire’s book *Pedagogy of the Oppressed* has long been considered an influential piece in critical educational thought. To achieve the aims of justice and equality, the teachers who embrace critical pedagogy must challenge their own and their students' well-established way of thinking that frequently limit their own principle (e. g. McLaren, 2006, & Kincheloe, 2008 in Tutak, Bondy, & Adams, 2011). It was very difficult time for me to challenge my *status-quo*; I could not challenge easily my deep-seated assumptions as they had been guiding me all the way during my long journey of mathematics teaching. However, once I began to practice critical pedagogy in teaching mathematics, I came to realise that critical pedagogy is not a one-size-fits-all pedagogy but rather a humanizing pedagogy that values students' (and teachers') background knowledge, culture, and lived experiences, moving students (and teachers) into their own ever-expanding interpretations of their lived worlds (Stinson, Bidwell, & Powell, 2012). In this regard, I remember when I first posed a question to my students of Grade IX in 2008, coming 'out of the box', changing the linear track of teaching contents of the textbook, "Can you measure how long this whiteboard is?"

Everybody began to guess by using the method of estimation.

"*About 2 meters …"*

"About two and a half metres …"

"About 1 metre and 70 centimetres …"

I immediately called a student forward and asked to measure the whiteboard exactly. He said, "How can I measure it, Sir? I don't have a measuring tape?" I said, "But I can measure it exactly without a measuring tape." All the students just stared at me and waited for my response. I used my hand to measure the length of the whiteboard, and they were speechless for a while.

"But is it possible to measure everything exactly in this way, Sir?"

"Is it reliable?"

These were their queries about my system of measurement. I reminded them, "Look, do you think we measure everything with standard measuring system in our practical life? … Just remember whether or not you have used a rope, hand, *bitta*[12], leap, stick, etc. in your life! …You might have heard from your parents that they measure the land by hands and buy and sell it!" Form their gesture I felt that I was able to convince them. I immediately posed another question:

"If 100 workers can build a house in 20 days, in how many days can 1 man build the same house?"

All the students engaged in solving the problem using unitary method and told "2000 days". I smiled at them and said, "Is it possible?"Most of them said, "Why not, Sir?" I laughed loudly for some time and said, "Who must be that lucky person who can build a house single handedly in 2000 days? Have you ever imagined how long is 2000 days?" They understood and laughed aloud with me.

Next, I posed a relevant question, "What is this?" I showed a marker pen to them. "It's a marker pen, Sir." I immediately responded, "But I say that it is a line segment." They made a good laugh. I continued further, "It is a line segment parallel to the earth surface while it is a line segment perpendicular to the earth surface." While demonstrating, I showed the marker pen horizontally to signify parallel line segment and vertically to signify perpendicular line.

"There is a famous story which you must have heard. Once upon a time, two persons were going to cross a river. One of them was a farmer and other was a mathematics teacher. The farmer belonged to the same village while the teacher had

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[12] Length equal to a palm from the tip of the thumb to the tip of the little finger

come to visit the place. Because of the heavy rain, the flood had swept away the bridge. The teacher asked the famer, "Tell me the depth of water in the river. I want to cross the river." The famer said, "It's not uniform. Here maybe 2 m deep, there 3 m but in the middle 6 m, next maybe 4 m and 1 m." The teacher just calculated the average depth of the river and said, "It's 3.2 m in average. So, I can cross the river." He went into the river and was swept away." Everyone laughed.

I said, "Raise questions about the things they are and learn to think in a different way. It's our habit of thinking and acting based upon what we've experienced in our past life. We go back to past life experiences, reflect on them and act accordingly. That's why; don't always follow the same methods as your teachers teach you. Sometimes you should think critically so that you can be imaginative and creative. Let me give a few examples about how mathematics can be helpful in social justice."

"When I was a child, I would see my father fighting with neighbours about land-dispute. My father was illiterate but clever. The neighbours wanted to seize our land. They would invite the land measuring officer themselves and measure the land. In response, my father would also invite another officer to measure the land. The neighbours knew that my father was ignorant but because of his clever mind, he could save the land from the neighbours. Do you know why I am telling this true story of mine to you? It's because it's about mathematics. If you learn mathematics meaningfully in school, you can measure your land yourself. Even you can save the oppressed people from such social injustices in your village. There are hundreds of examples in our village where the clever people have seized the land of poor and ignorant people; they have even cheated many people while lending money at high rate of interest."

This is how I have started teaching mathematics in the classroom using critical pedagogy: thinking and acting in a nonlinear way. I am happy that I have broken my famous 'banking pedagogy' in which I would fill students' minds as containers with the knowledge that I have determined they need to know (Freire, 1970, 1993). Now-a-days, I always encourage my students to learn mathematics contextually as possible as they can. I always try my best to stimulate them questioning but don't impose my views on them. However, there happen many incidents in which I have to forcefully impose my views on them so as to enforce them to engage in gaining procedural knowledge and skills that are needed to score good marks in exams. It is, I think, due to the disempowering features of mathematics education such as culturally decontextualised mathematics curriculum, disengaged pedagogy and sit-for-test assessment practices in Nepal (Luitel, 2009).

The next issue based on my long pedagogical practices that I and many of the students as well have realised is about students 'behaving as others' to adjust in the environment, for examples, people from lower castes, marginalized groups and deprived community behave as if from upper castes, elite groups and privileged community, and hence there is a danger of losing their identities. Though teachers are conscious enough about racial issues, I feel they are unknown about such issues of 'behaving as others', which has a great impact in students' natural learning. According to Tutak, Bondy, and Adams (2011), culturally responsive education can give those diverse students an option being academically successful while maintaining their culturally identities. I don't claim that my grade was (is) fully culturally responsive. However, I encourage students to respect each others' culture and maintain their cultural identities so as to empower every individual student.

I still remember an event of my teaching: Excited from reading the research report on "*Developing Culturally Contextualised Mathematics Resource Materials: Capturing Local Practices of Tamang and Gopali Communities*" undertaken in collaboration with the Kathmandu University School of Education within the UNESCO's regular programme on education, I in 2012 discussed about mathematics being practiced in students' cultures. When inquired, they were excited but most of them have lost their cultural identities. Orienting to their local and cultural practices, I designed project work on "Culturally Contextualised Mathematics" for the students of Grade IX. I encouraged them to inquire their parents, grandparents, locals from their community and find historical texts from various sources such as books, internet, etc. It was exciting about 50 % students did their research and submitted their report. I believe that such culturally responsive pedagogical practices helped me and my students to promote meaningful teaching and learning of mathematics in the classroom and encouraged them to recognize their cultural identities.

Based on my experience, in the Nepali context, it was quiet difficult to break the traditional way of teaching and learning and introduce 'critical mathematics education' for equity and social justice. Nonetheless, I started my pedagogical journey, at least, making my students aware about mathematics for equity and social justice. In this regard, Gustein (2003, 2006) identifies social pedagogical goals – reading the world with mathematics, writing the world with mathematics, and developing positive cultural and social identities. He further states: Reading the world with mathematics means to use mathematics to understand relations of power, resource inequities, and disparate opportunities and explicit discrimination among different social groups based on race, class, gender, language, and other differences. Writing the world with mathematics means to use mathematics to rewrite the world –

to change the world. Developing positive cultural and social identities means to ground mathematics instruction in the students' languages, cultures, and communities, while providing them with the mathematical knowledge needed to survive and thrive in the dominant culture (as cited in Stinson, Bidwell, & Powell, 2012).

Based on my experience, students in Nepal come to school with a huge aspiration of learning mathematics productively and meaningfully. However, most of them are found neglected, subordinated, abused or ill-prepared to learn and work productively and hence to address such power dynamics teachers should change themselves to teacher as social mediator, learning facilitator and reflective practitioner (Larrivee, 2000). In this regard, being a critical reflective practitioner, I began to examine my personal and professional belief system, as well as deliberate consideration of the ethical implications and impact of my practices.

It could be February 2015 when I began my journey of University teaching and taught the course "Curricula in Mathematics Education" for master's students at KUSOED. Though I tried my best to teach the course through inquiry-based learning, I was not successful as I could not build rapport with the students, I think, because of my deep seated schema of traditional culture of teaching. Upon my request, they sent their feedbacks via mails, a few of them are as follows:

"You are sound in content knowledge but you lacked competency while dealing with students."

"You explained things explicitly and focused more on theoretical knowledge, but we didn't get any practical knowledge of designing curriculum."

"There was a rare group discussion in the classroom and hence we couldn't get any idea about interpreting Habermas' three cognitive interests, which I felt was most important and difficult to understand theoretically and practically as well."

It was a challenge for me to become a university teacher. Despite having sound theoretical (content) knowledge, it was a tough gulp for me in translating “theories into practices”. Since then, I critically reflected on my teaching and reformed the teaching-learning activities for the next year. In 2016 and 2017, based on students’ feedback I was much successful in addressing the above feedbacks of the students. As I knew that it was also too difficult for me to understand Habermas’ three cognitive interests when I was a MEd and MPhil student. Reflecting on my life as a university student, I came to realise that I first should transform my ‘self’ so as to transform my students. I began to regularly interact with the students about many issues like: how they were feeling, whether they understood or not, what should be added to the course, what should be omitted from the course, how to write reflective journal, how to design curriculum, and many more. Because of this, I could win their heart and once they were in my confident, the classes ran very smoothly and effectively.

There were effective discourses while teaching the master’s course. Based on the feedbacks of the students, I prepared engaging activity plans with great effort so as to give something different than ever based on Grundy (1987). In this regard, I planned two activities:

<u>Activity 1</u>

- Students individually read the paper of Grundy (1987) from page 5-12 (up to technical interest) and collect the bullet points and share them in the grade [15 minutes]
- The Facilitator collects their bullet points on board and engage students in classroom discourse with the help of the bullet points [10 minutes]
- Facilitator read the paper [20 minutes]

<u>Activity 2</u>

- You are given two 1s. Each student work individually and form a new number. [You may use any algebraic operations or any other means]

➢ The Facilitator will note the answers on the white board.

1. How do you find your answer? Is it your pleasure that you connect with object or action to reproduce your prior knowledge? Do you have a logical reason why you wrote 2 as an answer?

➢ Think and give your answer carefully.

- You are determined, "I want 1 + 1 = 2."

1. Why do you think that this is the right answer?
2. What/who motivated you to follow such rules? Why?
3. Did you follow certain pre-existing rules to find the answer? Why?
4. Did you control and manage the environment according to your wish? Why?
5. Did you use individual effort to solve the problem by using different methods? Why?
6. Did you break the whole problem into several parts to generate the knowledge?
7. Did you use two or more propositions (axioms, postulates, formulae, etc.) based on the previous one to generate the knowledge?
8. Did you use deductive method to solve the problem?
9. What type of knowledge did you generate, objective or subjective?
10. As a teacher, have you ever applied the same method of teaching as your teacher used during your school?
11. What sort of mathematics curriculum do you envision based on technical interest?

12. Collect your lived and living examples based on technical interests.

- Discuss in groups under the following components: Goal of Mathematics Education, Pedagogy, Teacher's role, Student's role, Assessment, Parents' role, Role of school administration, Curriculum metaphors

While each individual student was sharing his/her views, I was too much strict to control the environment in the classroom. When somebody asked me a question, I directed them to learn and understand themselves so as to show that I was a 'technical' teacher. The students were very much surprised and upset, to some extent, from the way I was behaving in the classroom, which I could observe from their gestures and activities. Finally, I opened the secret why I was behaving in a different way, not listening to them and directing them to do this and that. They were overwhelmed. Based on their views, they had a wide interaction on Habermas' three interests and curriculum through the contextual problems as follows:

<u>Technical Interest and Curriculum</u>

Problem: You are given two 1s. Use them to form a new number. [You may use any of the four basic operations or any other means]

Interpretation of Habermas Interests

A. Whatever result (knowledge) you find is based on your prior knowledge and experience. It's your pleasure that you connect with object or action to reproduce your prior knowledge. You have a logical reason why you wrote 2 as an answer because you are a rational being. [Human Interest]

Interpretation of Technical Interest

B. I want $1 + 1 = 2$. [Technical Interest]

1. In your day-to-day life you always get 2 when you add them. It's the common practice in your community or society. This knowledge helps you survive in that community or society.
2. You think that it's most worth as per the need of your community or society and hence you are reproducing knowledge to survive in the community or society. Here, you're driven by the motive of your community or society.
3. While constructing knowledge, you follow certain rules or structures of algebraic operations [e.g. addition here] to find your intended answer (knowledge). It means that you control and manage the environment according to your wish by abiding yourself and others by the rules or structures until you achieve your objective.
4. Your interest here arises from inclination than reason as you believe in already established laws.
5. You may use different methods to get the result 2 (e.g. using materials, etc.) because you believe in 'what can I do?' to achieve the pre-determined outcome (knowledge) whatever methods you can use. Here, your individual effort counts much.
6. While solving problems, you may break down the whole problem into many smaller parts and see the cause and effect relationship among the parts to draw the conclusion. You also check either this or that, but ultimately you accept the one which you think most worth based on reasons. Here, you are more analytical. [Analytical Logic and genre]
7. You use two or more propositions (hypotheses, axioms, postulates, etc.) one after another based on the previous one to achieve your result. [Propositional Logic and genre (syllogism)]

8. You solve your problem deductively to reproduce pre-existing theories and perspectives instead of using inductive orientation of the problem. [Deductive Logic and genre]

For example: If you are given to factorize $x^2 - 9$, you use the already established formula:

$a^2 - b^2 = (a + b)(a - b)$ instead of using inductive method to see how this formula is derived such as $2^2 - 1^2$ gives the same result as $(2 + 1)(2 - 1)$ gives.

So, $2^2 - 1^2 = (2 + 1)(2 - 1)$.

Similarly, $1^2 - 2^2 = (1 + 2)(1 - 2)$; $(-5)^2 - 3^2 = (-5 + 3)(-5 - 3)$ and so on.

Generalization: $a^2 - b^2 = (a + b)(a - b)$

9. The knowledge (e.g. your answer 2) you have generated is objective and instrumental as it is an object residing out there which you should get by using pre-existing rules, laws, theories, etc. Here, your personal philosophy (subjective experience) does not influence you to achieve your result.

10. If you are a teacher and discover certain rule or law through a series of observations or experimentations, you train your students to follow the same rules or laws to promote learning. For example, when you were a school student, you might have experienced that physical punishment might have improved your or friend's achievement in mathematics learning. Based upon your prior knowledge and experience as a student, you apply the same method of teaching as your teacher did. Here, you believe that physical punishment is the only method of teaching to promote learning of mathematics. You do not see the flaws in your ways of teaching. You do not consider other psychological aspects of students. Rather, you just apply the pre-existing set of rules to train your students like animals are trained in circus. In such a situation, you control and manage the environment of the classroom accordingly to

achieve your teaching/learning outcome through rule following action based upon empirical grounded laws.

11. As a curriculum designer you develop the objectives model curriculum, which has specific objectives and learning outcomes so that at the end of teaching learning process, the product (outcome) will match with the *eidos* (i.e. the intentions or ideas) expressed in the original objectives.

At the end of class, I gave concluding remarks and assigned them homework: Reflection 1: Read the paper and write a reflective journal on the basis of today's classroom activities [500-800 words]. Upload your reflection in the KUSOED E-Learning site or mail it to the Facilitator [indramani.shrestha@gmail.com; indramani@kusoed.edu.np]

……….

The next week was the Habermas' Practical Interest. I reviewed the previous lesson of Habermas' cognitive interest and technical interest and started the class of practical interest as follows:

<u>Activity 1</u>

- Group Formation
- Students individually read the paper Grundy (1987) from page 12-15 (Practical Interest) and collect the bullet points , share with group members [15 minutes]
- Facilitator collect their bullet points on board and involve students on classroom discourse with the help of the bullet points [10 minutes]
- Facilitator read the paper [20 minutes]

<u>Activity 2</u>

- You are given two 1s. Discuss in your group and form a new number. [You may use any algebraic operations or any other means]
- Each group will discuss with their members to find a common answer and present their answer.
- Each answer will be discussed among all the students irrespective of their groups and generate a common answer from all the diverse answers.
- The teacher will facilitate to settle down through consensual understanding so as to generate a new knowledge (outcome).
- "We found 1 + 1 = 2 or …"

1. How did you find this answer in your group?
2. How did you use your subjective experience while discussing in your group?
3. How did you interact with the members in your group?
4. How did you come to a consensual understanding in your group?
5. How did each group share their knowledge (outcome) with other groups?
6. How did all the students actively take part in interaction during the classroom discourse?
7. Was your interaction meaningful?
8. How did you come to a general understanding?
9. Do you think that each one of your voices is heard?
10. Do you think that each one of your voices is addressed in your common answer?
11. Does everyone agree with the common answer?
12. If not, who is against this common answer?
13. How did you take part in meaning making process?

14. Whose voices are addressed, majority or minority? What about those whose voices are not addressed?
15. Do you think that you participated in democratic practices?
16. Why did you follow the democratic practices? Is it because you think that your fundamental need as a human being is to live in and as part of the world?
17. Did you keep records of all activities and convert them into texts so as to generate meaning through interpretation based on historical documents (e.g. literatures, etc.)
18. Is your common answer is judged rationally and morally with the help of the teacher?
19. This is your subjective action acting with another subjective action and *all* of you are able to construct a subjective knowledge.
20. The knowledge you have constructed is called a communicative knowledge, which is subjective and is derived through language and validated by consensual understanding of your friends and teacher.
21. The acquisition of such knowledge is the goal in the study of human relations, political and social systems, and education.
22. This is your subjective action acting with another subjective action and *all* of you are able to construct a subjective knowledge.
23. The knowledge you have constructed is called a communicative knowledge, which is subjective and is derived through language and validated by consensual understanding of your friends and teacher.
24. The acquisition of such knowledge is the goal in the study of human relations, political and social systems, and education.

<u>Practical Interest and Curriculum</u>

Activity: Group Discussion based on practical interest

Problem: You are given two 1s. Discuss in your group and form a new number.

[You may use any algebraic operations or any other means]

Answer: Your answers may vary person to person or group to group. Some find $1 + 1 = 2$, some 1 and 1 = 11, some $1 - 1 = 0$, some $1 \times 1 = 1$, $1+1 = 10$, etc.

Interpretations

A. Interpretation of Practical interest through examples: All the members in your group actively participate in interaction using their own prior knowledge. Everyone's subjective experience is acknowledged among the members in each group in the beginning, but finally the voices of majority win and a conclusion is drawn after the consensual understanding. [Interaction with environment and Consensual Understanding among the members of your group]

For examples:

1. Suppose most of the members of Group A are from the computer background. Certainly, they need their answer in base-two number system. Thus, the majority may draw the conclusion: $1 + 1 = 10$, because this is the knowledge they practice in their day to day life activity.

2. Suppose most of the members of Group B are mathematics teachers. Certainly there will be some constructs: $1 + 1 = 2$ or $1 \times 1 = 1$ or $1 - 1 = 0$ or $1 \div 1 = 1$. All of them will have healthy interaction among the members and come to any one conclusion with the consensus of majority. Here, they may agree with all the four knowledge.

3. Suppose most of the members of Group C are creative. They may think in a creative way and may find their answer as "1 and 1 also constitute 11".

4. Suppose most of the members of Group D are critical thinkers. All think that each of them is autonomous and responsible towards their society. Each of them thinks that their voices should be heard for better society. No one can impose their opinion or knowledge to them. Every individual feels empowered. Here, everyone is free from any dogmatic dependence and false consciousness. Such people do not agree with others' opinion, provided that their knowledge is based on "reason". [This is the case of emancipatory interest, which will be discussed in the next grade.]

5. Now there are four different (or some common) knowledge constructed within respective groups. All these knowledge will be shared among all the students in the classroom. They will have healthy interaction and try their best to come to a consensual understanding so as to draw a conclusion. Finally, the voices of students in majority will be heard and the conclusion will be drawn, which will be a construction of new knowledge based on consensual understanding. In this case, whatever consensual understanding is made, the teacher observes and asks the reasons behind your agreement and gives a white signal, thereby constructing new knowledge under consensual understanding. This is how practical interest helps generate knowledge through meaning making process. *However, this knowledge does not represent the voices of all the students in the classroom and this is why; practical interest generates knowledge that unites people with false consciousness.*

B. Comprehensive interpretations of Practical Interest

1. In the meaning making process, all of you share your understanding with your friends in the classroom. In this situation, the teacher observes the environment of the classroom and facilitates all of you to have a wide, healthy interaction among friends so as to draw a common knowledge (outcome) through a consensual understanding.

2. You individually use your opinions and ideas here. Your subjective experience is accounted here. In the same way, everyone's subjective experiences are accounted to reach to a consensual understanding. However, the majority wins in this type of general agreement. The voices in minority are heard but not addressed in the outcome. In the democratic countries like Nepal, the political party with majority wins to form the government and pass the various bills in the parliament house. [Here, everyone's voice is heard, but everyone's voice is not addressed]

3. This is your fundamental need as a human being to live in and as part of the world. This is your democratic practice to survive in the environment through consensual understanding, because you are always abided by your duty and responsibility towards the society as "What ought I to do?" always motivates you in this regard.

4. Here, you construct knowledge (outcome) through meaning making process. During the meaning making process, you interact with your friends in the classroom, poses questions, take and give healthy feedback/comments and draw the consensual understanding. Here you are completely involved in meaning making process.

5. Here at least two students are involved in interaction.

6. Whatever interaction occurred during meaning making process, all of you keep records [e.g. notes, photographs, etc.] and later, all of you will reproduce your actions as texts and interpret them to make meaning. In this situation, you interpretation should be connected to and based upon the historical documents (e.g. different research works and literatures). The knowledge thus obtained through interpretation and understanding is judged rationally and morally.

7. This is your subjective action acting with another subjective action and all of you are able to construct a subjective knowledge.

8. The knowledge you have constructed is called a communicative knowledge, which is subjective and is derived through language and validated by consensual understanding of your friends and teacher.
9. Practical interest constitutes historical-hermeneutic sciences which generate knowledge by the understanding of meaning and validated by historical and literary interpretation.
10. The acquisition of such knowledge is the goal in the study of human relations, political and social systems, and education.
11. Curriculum informed by practical interest is a curriculum as process. Curriculum design is regarded as a process through which students and teacher interact in order to make meaning of the world and which rests on teacher judgment, rather than teacher direction.

At the end of the class, I gave concluding remarks and told them why I behaved as a Facilitator, which was different than the last grade and finally assigned them homework:

Reflection 2: Read the paper and write a reflective journal on the basis of today's classroom activities [500-800 words]. Upload your reflection 2 in the KUSOED E-Learning site or mail it to the Facilitator [indramani.shrestha@gmail.com]

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It was the class of teaching Habermas' emancipatory interest. I first reviewed both technical and practical interests and started the emancipatory interest as follows:

<u>Activity 1</u>

- Group Formation

- Students individually read the paper Grundy (1987) from page 15-19 (Practical Interest) and collect the bullet points , share with group members [15 minutes]
- Facilitator collect their bullet points on board and involve students on classroom discourse with the help of the bullet points [10 minutes]
- Facilitator read the paper [20 minutes]

<u>Activity 2</u>

1. How does technical interest help construct knowledge?
2. How does practical interest help construct knowledge?
3. What type of knowledge is constructed through technical interest?
4. What type of knowledge is constructed through practical interest?
5. What is the shortcoming of technical interest?
6. What is the shortcoming of practical interest?
7. Are the members of fourth group D are free from any dogmatic dependence?
8. Are they liberated?
9. Are they autonomous? Why?
10. Are they responsible? Why?
11. How can each of them be independent from external forces?
12. Which interest is linked with autonomy & responsibility?
13. Which interest is linked with truth and justice?
14. Why do you think that technical interest does not facilitate both autonomy and responsibility?
15. Does technical interest arise either from inclination or from reason?
16. Why do you think that practical interest does not facilitate both autonomy and responsibility?

17. Why do you think that practical interest is inadequate for true emancipation?
18. How can there be true emancipation?
19. At what condition will the voices of all individuals be heard as well as addressed?
20. What kind of persons cannot participate in the act of speech?
21. In what condition does emancipatory interest construct knowledge?
22. How does the emancipatory interest translate into action in the real world?
23. Do you think that theories are sufficient for addressing emancipation? If not, how can they be authenticated?
24. Groups must be able to say not only 'yes, we are convinced that this is true', but also 'yes, that is also true for us!' – Discuss with your members in group.
25. Which cognitive interest generates a kind of knowledge called authentic insight?
26. The emancipatory interest is a fundamental interest in emancipation and empowerment to engage in autonomous action arising out of authentic, critical insights into the social construction of human society.
27. Emancipatory knowledge is guided by the paradigm of criticalism and is a product of critical self-reflection and critical reflection.
28. It involves the self-awareness that frees us from constraints.
29. The acquisition of emancipatory knowledge is transformative.
30. Thus, an emancipatory curriculum will work towards freedom on two levels:

✓ First: At the level of consciousness, the subjects participating in the educational experience will come to know theoretically and in terms of their own existence when propositions represent distorted views of the world (i.e.

views which serve interests in domination) and when they represent invariant regularities of existence.

- ✓ Second: At the level of practice, the emancipatory curriculum will involve the participants in the educational encounter, both teacher and pupil, in action which attempts to change the structures within which learning occurs and which constrain freedom in often unrecognized ways.
- Thus, an emancipatory curriculum entails a mutual relationship between self-reflection and action.
- Therefore, curriculum as praxis can be the form of the emancipatory curriculum which is authentic, inclusive, empowering, justifiable and socially constructed through action, critical self/reflection, interaction with the world and meaning making process.
- In the conclusions:
- ✓ Technical interest is concerned with *control* and *prediction*

  Type of knowledge: instrumental

  Way of knowing: knowing what (empirical-analytic)
- ✓ Practical interest is concerned with *understanding* and *interpretation*

  Type of knowledge: communicative

  Way of knowing: knowing how (historical-hermeneutic)
- ✓ Emancipatory interest is concerned with *freedom* and *empowerment*

  Type of knowledge: transformative

  Way of knowing: knowing why (critical)

<u>Emancipatory Interest and Curriculum</u>

<u>Activity</u>: Group Discussion based on emancipatory interest

Problem: You are given two 1s. Discuss in your group and form a new number. [You may use any algebraic operations or any other means]

Answer: Your answers may vary person to person or group to group. Some find 1 + 1 = 2, some1 and 1 = 11, some 1 – 1 = 0, some 1×1 = 1, 1+1 = 10, some 1 ÷ 1 = 1, etc.

Interpretation of Habermas Emancipatory Interest

1. As we discussed in the previous classes of technical and practical interests, the answers of above question may vary from person to person because of individual's subjective experience. In case of technical interest, the outcome (knowledge) is predetermined and is constructed after following certain procedures by using the established rules, propositions, axioms, postulates, etc. while in case of practical interest, outcome (knowledge) is constructed under consensual understanding after having wide interaction among the subjects and the environment. The technical interest gives rise to *objective* knowledge which is *instrumental*, while the practical interest gives rise to *subjective* knowledge which is *communicative*. In such situations, Habermas identified another cognitive interest, called emancipatory interest, which is an interest in freeing persons from *coercion* of the technical interest because of imposed rules and the possible *deceit* of the practical interest because of false consciousness.

2. The fourth (critical) group D of practical interest does not accept that each of them is free from any kind of dogmatic dependence. They are liberated from such dogmatism, but they are not autonomous and responsible. They are not autonomous, because they are not independent to make self-decision while constructing knowledge. They are not responsible because they are not accountable for the constructed knowledge. In such situations, everyone must be independent from all that is outside the individual which is possible through the interest in emancipation.

Such emancipation is a state of autonomy rather than libertinism. Thus, Habermas identified emancipation with autonomy and responsibility, which is the fundamental 'pure' interest grounded in reason. Such emancipation is linked with interests in truth and justice.

3. Moreover, the technical interest cannot facilitate autonomy and responsibility because it is an interest in control and arises from inclination, not from reason. An interest in control will certainly facilitate independence for some, but this is false autonomy, because it is an 'autonomy' which treats fellow humans and/or the environment as objects. Moreover, the technical interest gives rise to a sort of freedom which arises out of a Darwinian 'survival of the fittest' world view of the fundamentalist views that the earth was given to mankind to suppress and rule.

4. Further, the practical interest is closer but not sufficient to serve the interests of autonomy and responsibility because though it regards the universe as subject, not object, there is still a potential for freedom provided by consensual meaning and understanding. Moreover, the practical interest is inadequate for the promotion of true emancipation because of the tendency of persons to be deceived, even when understandings are arrived at in open discussion and debate.

5. Therefore, both technical and practical cognitive interests are insufficient to address the voices of every individual participating in interaction in a particular environment. If the voices of all the individuals are heard as well as addressed in the outcome (the constructed knowledge), there will be a true emancipation for all. Not only the voices of group D, rather the voices of all the groups A, B, C, and D will be addressed in the outcome. This is possible only when each and every individual actively and potentially participates in the act of 'speech'. For Habermas, those persons who cannot recognize the difference between true and false statements in some general

way cannot participate in such act of speech and won't be truly emancipated. Therefore, the emancipatory interest would construct knowledge through the act of speech only if all the individuals were to discuss all human experiences in absolutely free and uncoerced circumstances for an indefinite period of time.

6. How does the emancipatory interest translate into action in the real world? The emancipatory interest generates critical theories which are about persons and about society which explain how coercion and distortion operate to inhibit freedom. For examples, Freudian psychology is a critical theory about the inhibition of freedom in individuals due to repression; Marxism is a critical theory about the inhibition of freedom in whole societies; and various theories of ideology also address the problem of how interaction can be distorted or coerced by certain interests. But theories are not enough and hence critical theories must be authenticated for each individual or group. That is, groups must be able to say not only 'yes, we are convinced that this is true', but also 'yes, that is also true for us!' Authentication takes place through processes of self reflection. So, other type of knowledge generated by the emancipatory interest is authentic insight.

7. The technical and practical interests are concerned with control and understanding respectively while the emancipatory interest is concerned with empowerment, that is, the ability of individuals and groups to take control of their own lives in autonomous and responsible ways. Thus, the emancipatory interest is a fundamental interest in emancipation and empowerment to engage in autonomous action arising out of authentic, critical insights into the social construction of human society.

8. Emancipatory knowledge is guided by the paradigm of criticalism and is a product of critical reflection and critical self-reflection. It involves the self-awareness that frees us from constraints.

9. Emancipation is possible only when there is an act of self-reflection.

10. Emancipatory knowledge is an explicit goal in life skills learning, literary programs, self-help groups, women's studies courses, and community action groups.

11. The acquisition of emancipatory knowledge is transformative.

12. What does it mean for curriculum to be informed by an emancipatory interest? To understand emancipatory curriculum, we must grasp the shortcomings of the practical interest. The practical curriculum is a curriculum as a meaning-making process which may deceive us as to the true meaning of events. If true emancipation is to occur, it is important that the subject should be freed from 'false consciousnesses'.

13. Thus, an emancipatory curriculum will work towards freedom on two levels: First of all, at the level of consciousness, the subjects participating in the educational experience will come to know theoretically and in terms of their own existence when propositions represent distorted views of the world (i.e. views which serve interests in domination) and when they represent invariant regularities of existence. Second, at the level of practice, the emancipatory curriculum will involve the participants in the educational encounter, both teacher and pupil, in action which attempts to change the structures within which learning occurs and which constrain freedom in often unrecognized ways. Thus, an emancipatory curriculum entails a mutual relationship between self-reflection and action.

14. Therefore, curriculum as praxis can be the form of the emancipatory curriculum which is authentic, inclusive, empowering, justifiable and socially constructed through action, critical self-reflection, interaction with the world and meaning making process.

At the end of the class, I gave the concluding remarks and assigned them homework:

Reflection 3: Read the paper and write a reflective journal on the basis of today's classroom activities [500-800 words]. Upload your reflection 3 in the KUSOED E-Learning site or mail it to the Facilitator [indramani.shrestha@gmail.com]

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In the final day of the lesson "Habermas' Cognitive Interests", I assigned my students an activity to discuss about the curriculum based on three interests. They discussed in the first half of the class and shared their views in the classroom. Finally, we discussed about the Journals and the class was over.

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This is how I improved my pedagogical practices and tried my best to become a reflective teacher-practitioner. Moreover, it has become a crucial factor in enhancing my nonlinear ways of teaching mathematics in school too. I regularly interact with students and encourage them to actively participate in pair or group works and immediately note down important issues of the classroom. I often reflect my practices when I come back home and write journals. However, it is quite ideal to claim that I always write journals, rather important field notes help me interpret the problems so as to plan for the next day.

Key Message of the Chapter

In this chapter, I presented five narratives to portray how I incorporated both linearity and nonlinearity in the teaching and learning of mathematics so as to reduce my pedagogical ecotone and students' learning ecotone between cognitive and affective domains. Moreover, in course of teaching and learning of mathematics I often felt that something must be missing in learning and teaching of mathematics such as 'wow!' moments just like when we get success. I always thought why such excited moments could not be experienced in school education. My mind developed with an assumption that school is a factory of education where students are trained for the acquisition of knowledge and skills just like Frere's (1970) *banking education*, instead of engaging in deep learning, randomly just like a kid learns from his/her mother, father and other members of the family by seeing, looking, observing, involving him/herself in a natural environment. How beautiful life span was that when I as a child would make sense of the language by identifying patterns and connecting and storing them into mind. But as soon as I was admitted to the school, I lost those beautiful 'wow!' moments and gradually trained by teachers to follow 'dos and don'ts'. Yes, this is what I must be missing – the nonlinear ways of learning.

As I grew up gradually and upgraded to upper classes, I began to develop my habits of thinking and acting in a linear fashion, thereby gradually losing or reducing my natural nonlinear habits of experiencing the world. I began to feel that I was not learning mathematics *in situ*, rather I was learning in a controlled and managed environment in the classroom (Grundy, 1987).

Above all, however, I don't confirm and claim now that my learning was fully linear; rather my argument here is that my natural ways of learning were resisted, subordinated, neglected, reduced or stolen by linear ways of learning. I realise now that the pedagogical practices of my teachers was more of reductionist flavour which trained me to learn how to break down knowledge into tiny skills so as to get beforehand outcomes. As a result, I began to practice linear pedagogy for many years before I came to realise the meaningfulness of nonlinearity in teaching and learning of mathematics. However, once I began to implement nonlinearity together with linearity in teaching and learning of mathematics during my pedagogical practices, I began to realise the meaningfulness of the nonlinear teaching and learning approaches, thereby benefitting my students in learning mathematics meaningfully. Therefore, I realise and envision that the inclusion of non/linear in teaching and learning of mathematics helps both teachers and students establish inclusive, authentic, and empowering mathematics education.

CHAPTER V

SENSITIZED MATHEMATICS PEDAGOGY: ENVISIONING A HOLISTIC APPROACH OF TEACHING AND LEARNING

In chapter III, I articulated how disempowering features of reductionism persuaded me to promote linearity in teaching and learning of mathematics, thereby creating my pedagogical ecotone and students' learning ecotone between affective and cognitive domains, while in the subsequent chapter IV, I articulated how I incorporated nonlinear approaches of teaching and learning of mathematics in my pedagogical practices, thereby finding out ways of reducing my pedagogical ecotone and students' learning ecotone by giving emphasis on affective domain and various constructivist approaches of teaching and learning. In so doing, I presented various narratives so as to portray how I implemented non/linear approaches of teaching and learning for meaningful learning of mathematics in the classroom. Moreover, my journey of research inquiry began from articulating the problems of my pedagogical practices to finding out possible ways of reducing and/or solving those problems, thereby giving rise to pedagogical sensitisation in me so as to envisage holistic mathematics education..

Therefore, in this chapter, I have articulated how my pedagogical sensitisation encouraged me to envisage holistic mathematics education under transformative education. In this regard, this chapter addresses my third research question *'As a practitioner-researcher with transformative education research at my disposal, how does my pedagogical sensitisation help me envision holistic mathematics education through transformative education?'*, and portrays how I gradually developed my insightful towards pedagogy through transformative education so as to internalize and act as a holistic way of mathematics teaching and learning. For this, I have presented four narratives: *Holistic Pedagogy: Bridging Between Logos and Mythos; One-Size-Does-Not-Fit-All Pedagogy: Challenging the Status Quo; Culturally Responsive Pedagogy: Constructing Good Mathematics Teaching;* and *Critical Pedagogy: Empowering Myself and My Students* so as to depict how my ways of knowing got transformed into my ways of being/becoming through transformative education.

Holistic Pedagogy: Bridging Between *Logos* and *Mythos*

"*I am a disco dancer, tarara* …" I entered the classroom singing and dancing with book and teaching learning materials in my hands. The students joined me and there was good fun for a moment before I began the class formally. It could be any day of August, 2015 when I had been continuously teaching geometry in Grade IX for about a week using '*pipe pedagogy'* (Luitel, 2009) as if there was a pipe line between me and my students to transmit knowledge and skills without having any interference of anything like students' side-talks and gossiping, their day-dreaming, etc.

I realise now that I had been often using "a reductionist mathematics pedagogy that restricts students' opportunities to engage in authentic mathematical thinking and deprives them of the enjoyment of solving richer, more worthwhile problems, which would forge connections across diverse areas of the subject" (Foster, 2013, p. 563). More so, I comprehend that I had also been using "*logos*-oriented reductionist pedagogy which enhances orderly transfer of knowledge as if there is an ideal pipeline between teacher and students" (Leonard & Willis, 2008; Luitel, 2009). However, that day was a special day for me and for my students as well. I had made up my mind to have some fun in the classroom and hence had planned to connect geometry to students' culture of learning, to construct a bridge between mathematics and culture. Moreover, I also apprehend that I was going to use "*mythos*-oriented holistic pedagogy which constructs connections between culture, self and mathematics" (Leonard & Willis, 2008; Luitel, 2009).

"Dear students, today we are going to do something different than ever … Umm … You might have been boredom of doing and proving geometrical theorems … Today, I will give you a contextual problem of geometry and urge you to discuss in groups so as to find out its solution." As there was no any round table so as to conduct the group activity in the classroom, I suggested them to have discussions among their mates just sitting on own benches. I wrote the question on the whiteboard: *Pawan and Qureshi are standing on the circumference of a circular ground and Rinki at the centre to play a "Passing-Ball" game. If the perpendicular distance of Rinki from the line joining Pawan and Qureshi is 3 ft and the distance between Pawan and Qureshi is 8 ft, find how far Rinki is from each of Pawan and Qureshi. Draw a suitable figure and solve it with geometrical reasons.*

All the students engaged in solving the problem. I kept on my eagle eyes on them moving from student to student if they needed any help from me. Moreover, I had already taught them the geometric theorem based on this question. I observed how they would connect the geometric theorems to this problem. They were uttering words while solving the problems.

"Oh! What is this, Sir? I have no any idea in my mind …"

"This must be a theorem we learned … Umm … what was that …"

"I remember this game. We would play in childhood days. How entertaining that game was!"

"Sir, is this type of question also asked in exam?"

One group of students from the last bench called me and showed a figure they had drawn. “Bravo! You did it!” I said loudly and asked them to go in front of the class. After that, I asked one of them to draw the figure on the whiteboard and explained it to the class. One of them (the first boy of the class) did it. To make it more explicit, I added more from my side and said, “Now, remember a theorem we proved last week related to this theorem … Apply it to solve this problem.” The whole class engaged in solving the problems. Nonetheless, it was not like an ideal class where everything was perfect: Some students were still having problems. I assisted them and found that they had not understood the theorem at all. I reminded them the theorem once again and asked them to solve. Most of the students could solve the problems while some were still doing. However, finally, I wrote the theorem on the board related to that problem “The perpendicular drawn from the centre of a circle to a chord bisects the chord”, and solved the problem. Next, I assigned them a question: The line segment joining the centre of a circle and the midpoint of a chord is perpendicular to the chord. I said, “Based on this theorem, make a question of yourself and solve it.”

All the students engaged in their work actively while I was busy in assisting the weak students. The bell rang. I assigned it as homework. In the next day, I collected their homeworks and had a wide interaction about geometry and its application in their practical life-world.

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It could be any day of October 2015. The students of Grade X demanded me for some entertainment as soon as I entered the classroom. I had informed them last week that I would teach them “Mensuration”. They knew that I would fulfill their demand. It was because I had built up a good rapport with them and always tried my best to understand their feelings and supported them in solving their any kind of problems, personal or social as possible as I could. In this regard, I had to sometimes argue with the Principal of the school so as to get permission. It was because in Nepal there was (is) a culture of engaging students of Grade X all the time in study so that they wouldn't divert their mind from study with an assumption that the degree of engagement in study is directly proportional to the scores in SLC (SEE) exams. However, the long experience of teaching made me realised that how difficult time they might be having while they would sit on the same bench for long and listen everyday to the instructions and lectures of eight teachers of eight different subjects in a controlled and managed environment of the classroom.

"Okay, done!" I said, "Tell me what I can do for you!" They asked me to play songs from 'YouTube'. Before that, I said, "I will play only one song. After that, we will play mathematical games. Is it okay?" They agreed. I turned on 'Wi-Fi' in my cell phone and searched some Nepali songs in the 'YouTube' and played a beautiful song. As soon as the song was over, they clapped and roared to express their joys and happiness. At the end, I asked them to shout loudly so as to reduce their conserved energy.

"Thank you, class! Please, settle down! Now, it's time for a mathematical fun game. Get ready with pen, paper and calculator, and listen to my instruction carefully … The game is about how to find your house number and age. Are you ready?" I then instructed them as follows:

Write your house number. If you don't know, choose any number. For example, I choose 36.

Multiply it by 2: 36 ×2 = 72

Add the product to the number of days in a week, i.e. to 7: 72 + 7 = 79

Multiply the sum by half century i.e. by 50: 79×50 = 3950

Now, add the product to your age: 3950 + 42 = 3992

Next, subtract the number of days in a year from the sum: 3992 – 365 = 3627

Finally, add 15to the result: 3627 + 15 = 3642

The game is over. Now, find out your house number and age from the final result. The first two digits give your house number (36) while the last two digits give your age (42). Did you find?

After this game, I moved to the next activity and said, “Can you write the squares of 1, 11, 111, 1111, 11111 and son on mentally without using calculator?” No one was there to do it. I then wrote the squares of these numbers:

$$1^2 = 1$$

$$11^2 = 121$$

$$111^2 = 12321$$

$$1111^2 = 1234321$$

$$11111^2 = ?$$

“Now, observe the patterns and guess the square.” They immediately did it. “Now you can try it up to nine ones. After that I don’t think this rule works.” Finally, I promised them that I would take them to the audio-visual (A-V) room for some activities and the class was over.

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As per my promise, some days later, all the students gathered in A-V room for

learning something about “Mensuration” early in the morning at 6 am for a two-hour class. I was going to show them

some videos of making three dimensional objects – cuboid, cube, cylinder, triangular prism, cone and pyramid using paper cutting and folding method. First, I showed them videos of each object, demonstrated from my side and asked them to make the objects. I assisted them during the whole activities. It took three consecutive days to accomplish all the activities.

During the activities, I kept on interacting with them and based on the interaction, I realised that they were able to conceptualize surface areas and volume of the objects and construct meanings from them. I was very happy that almost all the students were engaged in the activities. Two students were absent in the first day. However, I talked to them personally and they were regular for the next two classes. More so, while teaching the same chapter theoretically, I connected both procedural skills and conceptual knowledge of making the objects to derive the surface areas and volume of the objects. It was much easier for me to demonstrate different parts of the objects such as base, lateral surface, vertical and slant heights of cone and pyramids, which, based on my experience, most of the students wouldn't conceptualize easily while solving the problems just through figures. Upon interaction, here are what they had to say:

"It was awesome experience, Sir. We never got any chance of learning mathematics practically before you came to this school. Thanks for everything you have done for us. We are grateful to you, Sir!"

"It helped me to find the slant height and vertical heights of cone and pyramid."

"Wow! It was wonderful having got practical experience."

"While solving problems, I first remember how I did it in the AV-room and connect those ideas to solve the problems. It's easy."

"I have still some confusion in recognizing the lateral surfaces and total surface areas of compound solids."

I think, most probably, I used the procedural and conceptual knowledge and skills as an iterative process (Rittle-Johnson, Siegler, & Alibali, 2015) in these activities. More so, I could also help students develop their instrumental understanding and relational understanding (Skemp, 1970) of mathematics by engaging them in the activities. It was interesting to see them busy in doing, constructing and inferring mathematics. I now realise that my sensitisation towards mathematics pedagogy helped me and my students to envision a holistic way of teaching and learning of mathematics in the classroom. Moreover, since the time I began to practice transformative research from my MEd study in 2007, I gradually began to draw on my past experiences so as to envision holistic way of teaching and learning of mathematics. I must admit here that being an adult learner-teacher, all the knowledge, assumptions, experiences, beliefs, values, and abilities I acquired during my childhood and adolescence became a foundation in order to assist me to understand new subjective experience (Mezirow, 1997), thereby enhancing me to promote both *logos*- and *mythos*-oriented mathematics pedagogies iteratively.

At this stage, I don't claim that I always conduct/ed all of my classes in Grade IX and X in the same passion of 'theory into practice'. There were/are many challenges and constraints that didn't/don't allow me to take the practical classes for each and every chapter. First, even the mathematics curriculum didn't incorporate practical exam though recently on 2017 most of the subjects incorporate practical exams. Second, I had/have to manage everything such as time, resources, power-cut (load-shedding), expenses, etc. In this regard, I always had/have an indirect pressure and challenge of making students capable of scoring better marks (grades) in the mathematics exams. Based on my experience, I found that the most of the parents and schools in Nepal wish/ed their children score better marks (grades), regardless of concepts they develop/ed. There is a popular culture in Nepal (most probably all over the world, I guess) that most parents ask their children what marks (grades) they scored instead of asking what they learned.

However, I was/am very happy to be sensitive towards using both reductionist (linear) and holistic (non/linear) approach of teaching and learning mathematics since 2007. Therefore, I was/is gaining the idea of how skillfully my beliefs, values, attitudes and emotions towards both reductionist (linear) and holistic (non/linear) mathematics pedagogies gradually developed in me should be implemented in the classroom teaching and learning processes, thereby strengthening my critical thinking and acting. In this regard, I have become pretty aware about the assumption that 'reductionism and holism are like the microscope and the telescope' (Raman, 2005, p. 252) – different but equally important tools (Foster, 2013). Based on experience of practicing transformative education, I came to realise that reductionist approaches have an important role to play for teachers and students as well to simplify a complex problem, and *logos*-oriented approaches also have an important role to play for teachers in transferring knowledge and skills to students, provided that teachers use both holistic and *mythos*-oriented approaches to connect mathematics to their selves and cultures. I believe that neither of these pedagogical approaches single handedly can enhance meaningful teaching and learning of mathematics in the classroom, they should go iteratively.

Sometimes, when I reflect on my ways of teaching in the classroom, I feel that students may think me 'crazy', because whenever I notice that students are feeling boredom of doing and learning mathematics, my classes become informal: For their benefits, I become humorous, sing and dance, talk funny words, give nicknames to them, ask them what nicknames they have given to me, get tempered and scold, love and care more than they have expected, emotionally blackmail them, refer their names to the Principal in case I can't handle them, praise for their improvement but make fun of them for scoring poor performances in the unit tests and term exams, and many more. Most importantly, because of my firm belief in the roles of women empowerment in holistic development of the nation, I often encourage girls for better education so as to be able to claim and secure their pertinent role in their family, society and nation. All I did/do was/is to try my best to make classroom environment alive as I feel that the classroom environment becomes lifeless if they have to continuously listen to their teachers' lectures and instructions just sitting on the same bench/chair in the same classroom for the whole day, week, month and year. In this regard, when I ask/ed them if they think/thought me crazy, here are/were what they openly share/d their views with me:

"Not only crazy, you are like mental, ha ha ..."

"It's fine, Sir. We never know when the class was over because of your funny activities."

"Sometimes, you cross the limit, Sir."

"You are humorous but very serious about our study."

"We feel that you are our friend."

"It's like you are our god-father"

"Let's play tabla[13] on your bald head, Sir."

[13] The *tabla* is a musical instrument, consisting of a single headed barrel shaped small drum. It is originated from the Indian subcontinent used in traditional, classical, popular and folk music.

"Your encouragement, love, care and passion of teaching are outstanding."

"I am afraid of your short temperament but I love your positive attitude, Sir."

"Sometimes, you irritate us when you make fun of us by giving different nicknames."

"You are talented, supportive and respect our feelings."

"You always try your best to address our voices and help us solve our problems."

The above anecdotes explicitly describe my character. Even I can't understand what sort of teacher I am – humorous or/and responsible! However, I observe/d if students were/are crossing the limit and remind/ed them their discipline and why I behave/d in that way in the classroom. Moreover, my attempt of being close to the heart of my students has been helping me in dealing with their problems. I scold because I encourage and help them; I give them their nicknames because they also give me the nickname *IM Taklu* (IM bald). While they are busy in solving mathematics problems, I sometimes put off my cap and tell, "*Taaloo maa aaloo phalyo hau timi haru laai bujhaundaa bujhaundaa*"[14]. They laugh wildly and some say, "Your head is like an airport, Sir." While others add, "If you stand in an open ground, the pilot will land the airplane on your bald head".

Despite having such funny things, my students give respect to me and take respect from me. Best on my experience, I have hardly found any students who spoiled their study because of my funny behaviour in the classroom. However, naturally everything in this world is not linear rather life moves on randomly and nonlinearly, so far. As a human being, I do mistakes. Nonetheless, I realise it sooner or later and talk to my victimized student to improve relationship so that he/she

[14]Trans: A potato was grown on my bald head while explaining things to you; meaning that it's a tough gulp for me to make my students able to understand what I teach.

doesn't spoil his/her study. I remember an event of September, 2015 during the extra classes of Grade IX at 6 am. I was about to start the class. Two students, a boy and a girl, brother-sister in relation, came in the class lately. I noticed that the girl just began to gossip with her mates beside her. I reminded the whole class to pay attention. Despite giving repeated warnings, she just continued her gossiping. In turn, I scolded her very badly and continued my class. During the whole class, I noticed her that she was very quiet and so were others.

Since then, she never greeted me for three days in a row. I observed her behavioural changes towards me. Later on, I realised that I should talk to her immediately before things got worst. The next day; I called her and took to a corner of the school ground and talked personally why she was behaving in that way. She said, "Sir, when you scolded me, I was not talking rather my friend was insisting me to talk with her. But I have nothing against you; I have forgotten all." I said, "I am sorry for that. I think you know me I never take such things personally in my mind for long. But how could you take it personally and keep it in your mind for long, dear? You are one of the brilliant students of the class. You must forget such minor things and move forward." She said, "I am sorry, Sir … I have a feeling that I can never do the best in Optional Mathematics. That's why; I am hardly attentive in your class. I always wish to get 90 plus but during exam I get nervous and spoil my exam." I said, "No worries! I will help you in that case. Just focus on study." After having conversations for about half an hour, we departed. Since then, everything was settled down; she was closer to me and so did I. She gradually improved and surprisingly scored marks between 80 and 90 out of 100 in the final exam of Grade IX. She personally met me and greeted me with vote of thanks and *jilevi*[15]. Finally, in Grade X she improved in both compulsory and optional mathematics hugely and never tired of giving all credits to me. To her best performance, she scored A + (90-100) in SEE. She still sends me *jilevi* via her sister who studies in Grade IX.

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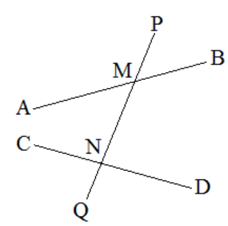
In course of practicing holistic approach of teaching and learning of mathematics, I had to face many challenges. I remember an event: In 2014, about 75 % of the students of Grade IX failed in compulsory mathematics while the (so called) best students could score unexpectedly poor marks than ever. Since it was my first year of joining this new school, I found everything humbled-jumbled in the school: Most students were weak in mathematics. They even didn’t have basic knowledge of mathematics. I talked to the Principal for the remedial classes and hence started about a month earlier than the first term exam. However, the school stopped the remedial grade right after the first term result. When inquired with the Principal, it was because despite conducting remedial classes, the students failed, and I heard that some parents complained why their wards failed and hence would not pay extra for the remedial classes. I talked to the Principal very sincerely and said, “How would you run your school, Sir? Is there any magic key to improve students’ performances in short time? If you have got any magic key, please tell me. Otherwise, either say goodbye to me or continue the remedial grade.” Moreover, the Principal is my friend and had worked as a teacher under me as Vice Principal some years back. That’s why; I could talk to him outwardly. Immediately, the remedial classes resumed.

Now it was a great challenge for me. At this state of mind, I felt that my students were shrunk to practice only cognitive skills and lacked metacognitive skills.

[15] A kind of local sweet which is spider-web in shape and made from flour fried on vegetable oil and soaked in the sugar solution for few hours

Moreover, cognitive skills are necessary to perform a task while metacognitive skills allow us to understand how the task was performed (Garner, 1987). Based on my experience, I realised that I might have helped my students exercise their mental processes involved in gaining knowledge and comprehension, including thinking, knowing, remembering, judging, and problem solving, thereby providing very rare opportunity of practicing ‘thinking about thinking’ – metacognition which is knowledge and understanding of our own cognitive processes and abilities and those of others, as well as regulation of these processes (Special Education Support Service, 2009). In this regard, I made a tentative plan of metacognition for the students.

In the first day, I took an oral survey on the part of Mathematics in which they needed my help the most. Unsurprisingly, they wanted to learn geometry from the very basic. I made an immediate plan to review basic geometrical axioms and postulates they learned in Grade VIII. Based on my experience and Foster (2013), since I was cultured with pedagogic reductionism *for* students in which teacher breaks down subject into tiny knowledge and skills to make things easier to learn for students, I had to develop a culture of pedagogic reductionism *by* students in which teacher facilitate students to break down subject into tiny knowledge and skills and learn meaningfully. In this regard, I drew a figure on the whiteboard and put a question: Discuss with your friends in your respective group and recognize the pairs of alternate angles, corresponding angles and co-interior angles. Unfortunately, desks and benches were immovable and hence could not be rearranged for group discussion. For that, students from each bench constituted a group.

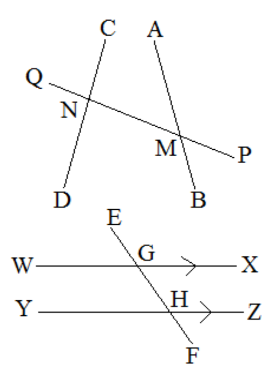


Surprisingly, they asked me a common question, “Is it possible to find the alternate, corresponding and co-interior angles when the two lines are not parallel?”

From their question, I interpreted that either they were not taught those pair of angles when the two lines are not parallel, or they forgot what they learned in Grades 7 and 8. When inquired, they told me that they had no idea about it at all. After all, I had to convince them that they exist even if the two lines are not parallel. Later on, all the students engaged in discussion while I observed each group very intimately. I saw them thinking, interacting and arguing with each other: some were shouting at each other, some were asking and others were trying to make things clear, and of course, they were writing and rubbing. I was happy to see the students engaged in learning by doing. After about 10 minutes, I asked each group to tell their findings which I wrote on the whiteboard. I noticed that they did the job flawlessly. Finally, I asked a question, "Are these pair of angles equal?" They said, "No." I said, "Why?" They said, "Because the two lines are not parallel. We can also see in the figure that their sizes are different; one is bigger and the other is smaller …"

However, I made up my mind to use an evaluative pedagogic reductionism to check if they had really understood conceptually. I rotated the figure and asked them to do the same task. In the mean time, I went off the classroom to collect some sticks. When I came back after a while, I found them busy in discussion and saw some of them having some confusion. I helped them and finally they accomplished their tasks. Next, I drew some different figures on the whiteboard and asked them individually to recognize different pair of angles.

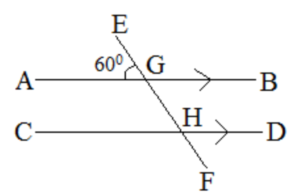
Once I was confident enough that they learned to recognize different pairs of angles, I drew another figure in which the two lines were parallel and asked them to write the pair of angles and differentiate them from the previous pair of angles. After having interaction for some time, they were able to conclude



that: If a straight line cuts two parallel lines, then (i) the alternate angles are equal, (i) the corresponding angles are equal, and (iii) the sum of two co-interior angles is two right angles. More so, they were also developed a conceptual understanding that all of the above statements are not true if the two lines are not parallel.

Finally, I took the help of a few students and demonstrated the pair of angles using sticks. Before the one-hour grade was about to finish, I informed them that they would be doing the problems related to those pair of angles.

Next day, everyone was ready. I reviewed the lesson. For that, I drew a figure and asked them to recognize the alternate angles, corresponding angles and co-interior angles. I also asked them to tell and write the statements. It was because in Nepal, students' performance was/is evaluated only by written tests and exams, not by any other curricular activities. I had to make them able to represent their mental images (concept) through writing. Unless they were able to translate their ideas and concept residing in their mind into writing, I would be an unsuccessful teacher. That's why; I asked them to recite the statements of theorems five/six times and hence asked to write on their exercise book. They did and I wrote a question on the whiteboard: In the adjoining figure, AB // CD and $\angle AGE = 60^0$. Find all the remaining angles.



I allowed them to have a wide interaction in the classroom and just observed and encouraged them to engage in problem solving process. I found a few of them very weak in solving problems. Upon interaction with them, one of them said, "I know it, Sir. But I don't know how to present the answer." I understood that he had concept in his head but couldn't translate it into writing. For that, I solved a problem explaining the procedures in his exercise book. In turn, they engaged in problem solving and finally could solve the problem.

Since I was still revising the basic geometry which they learned in Grade VIII, I had to jump into the next topic without wasting much time on the basics. I asked them if they still remembered the tests of congruency of triangles. A few began to say randomly, “ASA … SAS … RHS … AAS … SSS … AAA … ASS …”[16] I wrote on the whiteboard and said, “Do you think all the tests are true?” The grade was silent. I said, “Out of these, two are incorrect. Can you tell me which they are?” The smart boys and girls then said, “They must be AAA and ASS.” I said, “Okay, fine. Can you draw triangles and explore why they are incorrect? Please, discuss with your friends.”

It was a very tough task to engage students in group discussion. Based on my experience, in Nepal, sometimes some students don’t show their innate interest and began to gossip; they usually go off-track during group discussion. The reason behind it could be any but for the time being, I had to intervene and encourage (or scold sometimes) them for group discussion. However, I helped them to inquire and investigate deeply.

After all, no one could tell why the two tests were false for the congruency of triangles. I said, “Leave it for now. Recall from grade eight and check how other five tests hold true.” I left them for their deep engagement in group discussion, observed each group and assisted them to connect their emerging ideas to one another. Finally, they could do it collaboratively. More so, I had to explain why the tests AAA and ASS are false for congruency of triangles. Here is what I did:

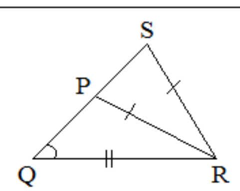


Fig. 1 ASS test of congruency does not hold true

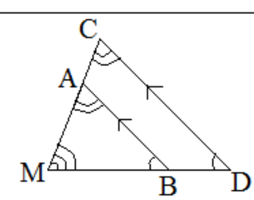


Fig. 2 AAA test of congruency does not hold true

[16]A stands for Angle and S stands for Side

<u>Explanation</u>: *In the fig. 1, triangles PQR and SQR are not congruent though ASS holds true for both the triangles. In fig. 2, triangles AMB and CMD are not congruent though AAA holds true for both the triangles.*

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I think I have begun to encourage my students to practice the 'emergent' features of mathematics through engaging discourses (e.g. Kuhn, 2008; Walshaw & Anthony, 2008; Luitel, 2009). This is because I believe that mathematical objects frequently possess emergent properties that are not features of any of their constituents (Foster, 2006, 2013). Based on the above narratives, I also feel that most teachers only teach those contents which they believe most worth in terms of exam while they even don't attempt to encourage students to inquire the emergent properties of mathematical objects. For example, in the above narratives, the students have no idea about the alternate angles, etc. if the two lines are not parallel. More so, based on my experience I have hardly found teachers explaining why AAA and ASS tests cannot be applied in congruency of triangles. I think it could be due to the reductionist mathematics curriculum which provokes teachers to take shelter of linear pedagogic model. Nonetheless, my university education at KUSOED has strengthened my ways of knowing holistically that the hegemonic of such a linear pedagogic model is not very much supportive for teachers to embrace self-reflection, critical contemplation and creative visions of their pedagogies arising from sociocultural and political renderings (Walshaw, 2004; Luitel, 2009).

Moreover, I believe that just involving students in group discussion to learn the same contents in a linear way does not promote an engaged learning. Unless students are encouraged to critically discuss and investigate the emergent properties of mathematical objects (any related mathematical contents), there is no meaningful learning in the classroom. Henceforth, such *logos*-oriented pedagogy encourages students to generate 'instrumental knowledge' (Habermas, 1972, 1974; Grundy, 1987). However, I believe that it is my pedagogical sensitisation towards mathematics that I have begun to practice both reductionist and holistic pedagogies as possible as I can despite having and facing many challenges, thereby bridging between *logos*- and *mythos*-oriented mathematics pedagogies as the constituents of reductionist and holistic pedagogies respectively, so far.

One-Size-Does-Not-Fit-All Pedagogy: Challenging the Status Quo

"*Sir, it is quite difficult to handle a student in my grade! He is brilliant but restless! Once he completes his work, he starts to disturb others … Even he moves from one place to another. Any means of handling him is just in vain! What to do?"*

"How can we help weak students improve in mathematics, Sir?"

"Oh, it is quite difficult to manage students in such a diverse classroom! A few meet the level while the rest are below the level … I am in dilemma how I should take both kinds together! The school should be selective while admitting students …"

The above are the anecdotes that I often hear from the teachers of my school during formal or informal interaction.

What could be the reasons behind these issues? Why is the student so restless? Can there be any means of controlling him or can his nature of restlessness be transformed into his strength that is beneficial for the whole grade? More so, who are weak students in learning mathematics? Is it due to learning disabilities or due to something else? Does a teacher have any instrument of measuring the learning disabilities of students? Most importantly, can a teacher help weak students improve in learning mathematics meaningfully? (e.g. Gardner, 1983; Fierros, 2004).

My classroom is diverse and multicultural. Many students from every corner of the country are available in my classroom. Does a teacher respect and preserve the cultural identities of all students in such a multicultural classroom? Does a teacher address the beliefs, values, attitudes and emotions of students towards mathematics in such a multicultural classroom? How should a teacher manage teaching and learning of mathematics the mixed-ability classroom? Can I respond to the needs of all learners in mixed-ability classroom? (e.g. Tomlinson, 1999, 2001)

Above all, there were many issues raised in my mind in due course of research inquiry. As a transformative teacher, how should I address these issues during my pedagogical practices? Here came an idea in my mind: Can one-size-fits-all pedagogy solve such problems? Based on my experience and various literatures, I pulled out myself of the monotonous, hegemonic and universal pedagogy that had been my principal pedagogical tool of teaching mathematics. Eventually, I was thoughtful and began to unlearn. I raised questions to myself and realised that I should not be an authoritarian teacher; rather I should be flexible teacher. I should look for many ways of teaching mathematics in the classroom. I should find ways of addressing each and every individual in the classroom. In so doing, I should be able to employ 'one-size-does-not-fit-all' pedagogy in the classroom (e.g. Luitel, 2003, 2009).

Since the time I began a teacher with transformative sensibility during my master's study (e.g. Shrestha, 2011), I came to realise that I should transform my ways of knowing and being so as to get my pedagogical practices transformed. However, it was a very tough gulp for me to accept the living theories (Whitehead, 2008) of mine and students because of my schema and habits of mind (Mezirow, 1991) that had been set into my mind for many years. Nonetheless, I dared and kept on my spirit of practicing different pedagogical practices so as to address the issues of all students in the classroom. Up till now, that is in the tenure of MPhil study, I became much more flexible in selecting pedagogical tools realizing that one-size-fits-all pedagogy is not going to work out at all. In this regard, I began to ask each and everyone who can tell something about how to address the issues of every individual in the classroom so as to improve their mathematics learning. I also went to the shelter of various literatures (e.g. Luitel, 2009, 2013; Taylor 2013; Tomlinson, 1999, 2001; Gardner, 1983; Fierros, 2004) so as to gain theoretical referents.

Owing to these issues, after getting theoretical knowledge, I began to introduce one-size-does-not-fit-all pedagogy in my pedagogical practices and hence began to experience the same kind of issues that teachers usually raised regarding students' learning disabilities, restlessness and teaching in mix-ability classroom. Once I got involved with students' learning realm, I had a major focus on how students learn rather than what students learn (Tomlinson, 2001). Moreover, I was always thoughtful about the quote of Sarason (1990), who said:

> A different way to learn is what the kids are calling for . . . All of them are talking about how our one-size-fits-all delivery system – which mandates that everyone learn the same thing at the same time, no matter what their individual needs – has failed them (as cited in Tomlinson, 1999).

It could be any Saturday in October 2016. The second term exam result was published and the school was distributing report cards while teachers were busy in having interaction with the students and their parents about their performances. I as a secondary mathematics teacher was also busy in acknowledging students' effort for their good result and convincing some parents about how to improve their children's low performances. In the mean time, the parents of two students approached me to discuss about the poor performances of their children.

"Please, look at the result of my son, Sir", said one of them. As soon as she handed over the report card, the other lady said, "Look at this result too, Sir!" I took both the report cards. I knew that both had obtained the single-digit marks in mathematics. I said, "Both of these students are very weak in basic mathematics … they could have learnt in earlier classes …" Before I completed my sermons, both of them began to pour their dizzy sermons.

"Sir, it's been his about a half year in Grade Nine."

"How could you say so insincerely that they are very weak in basic mathematics?"

"Why didn't you inform us earlier?

"You could have informed us earlier about his weaknesses."

"He was good in mathematics in the previous school."

"Since the time I admitted my daughter in this school, her performance in math is going down … Even we have given her a private study room at home."

I just kept on listening to them for a while and immediately intercepted them, "Please, cool down, Madams! Unnecessary arguments do not give us solutions. Let's come to the point and have discussion on how we can solve the problems …"

They cooled down and I began to convince them that I would find the main reasons behind their poor performances. After having hot conversations, I suggested them to meet the Principal and they went to the Principal's office.

"Huh!" It was so unpleasant moment for me as a mathematics teacher for being challenged my profession by parents. In the mean time, I was too much carried away and almost lost my temperament. Having long been serving as a mathematics teacher and educator in different schools and university, I had encountered so many such incidents with parents. After all, I was able to come out of such vulnerable circumstances. However, at the very moment, it was not the primary concern of how I could be able to handle that situation rather I was too much concern about why I couldn't notice these students in the classroom. It deeply struck on my heart and mind.

Regarding the biographies of these two students, I knew that the girl was admitted directly in Grade IX that year in April while the boy was our school's product. After the closing of the report card distribution, I discussed about the matters of the boy with the teachers who taught him in the earlier Grades and collected much information about him. I also met the Principal and discussed about the matters sincerely. When I recalled the conversations with the mother of the girl and noticed that the girl was provided a separate room for her at home, it clicked in my mind and hence I discussed this matter with the Principal. Finally, we concluded that remedial classes should be run immediately for the weak students. We selected 20 students who scored less than 40 marks. More so, at the same time, the science teacher also demanded the remedial classes for his subject. The Principal sent the notice to their parents to send their children for the remedial classes of Science and Mathematics from 7 am to 9 am, one hour for each subject.

Based on my experience, the first and foremost factor of meaningful learning is student's readiness. Unless students are ready to learn, there is no/less meaningful learning. They need to be prepared first before teaching any content in the classroom. Therefore, the first day of the remedial classes was spent on counseling and making them aware of their responsibilities. It was a tough time and challenging for me to differentiate them in terms of their learning patterns. However, on the basis of their answer sheet of the second term exam, I had already noticed the common problems that most of the students were weak in basic algebra which, in turn, had caused further problems in solving the problems in other areas such as geometry and mensuration. In

Nepal, by hook or crook, students have to learn list of formulae while most of them had spoiled their exams because of using wrong formulae. Regarding geometry, I found them lacking in conceptual understanding as well as procedural skills. Owing to these assumptions, I said to the grade, “In which area of Mathematics would you need my help?” Everyone was quiet. I continued, “Would you prefer to learn basic Algebra such as factorization?” Most of them agreed. However, I interacted with every student individually about their problem. Finally, we decided to start the remedial classes with basic Algebra.

During counseling, I assured them not to get frustrated as they would improve gradually. Nevertheless, I also reminded them that there would be no any room for their excuses. It is because in due course of teaching, I have also found some naughty students who have a dual character: they say one thing in the school, the other thing at home, and escape from both sides just by making both the teachers and their parents fool. However, I warned them not play such dirty games.

About 15 minute earlier the end of the class, I intentionally sent out all the students except the boy and the girl whose mothers argued with me during the report card distribution day so as to talk to them personally. First, I talked to the boy intimately, advised him to do homeworks regularly and sent him out. Finally, I talked to the girl about the matter of using cell phone at home. I directly asked her if she would engage in cell phone. At first, she denied. However, when I warned her that you would be inquired from her parents or her cell phone record would be checked, she admitted that she engaged herself in cell phone sometimes in her private study room at home. I convinced her how cell phone kills her time and diverts her mind from study. Finally, she promised me that she would not use cell phone until she would improve her performances. I informed the Principal to call her parents to the school, and in the very next day we requested them not to give cell phone to her and observe her activities at home without her notice as well.

When I came back home, the whole night was spent on planning for the next day's classroom activities. I searched for many literatures in my laptop library that would give me some insight about the matter – a few of them were Vygotsky' ZPD and social learning theory, Tomlinson's Differentiated Learning, Gardener's Multiple Intelligence, von Glasersfeld' (1995) Radical Constructivism, Paolo Valero's (2014) Socio-political Perspective on Mathematics Education, Critical Pedagogy for Critical Mathematics Education of Tutak, Bondy and Adams (2011), Critical Pedagogy and Teaching Mathematics for Social Justice of Stinson, Bidwell and Powell (2012), Mezirow's Transformative Learning, Taylor's (2013) Transformative Education Research, etc. In addition, most importantly, I needed some local literatures so as to connect the problems to the context and hence revisited the works of Luitel (2003, 2009, 2013, 2017, etc.), Qutoshi (2016), Pant (2015), and Shrestha (2011). Finally, I made a tentative plan for the next day's class and went to the bed very lately.

There were 20 students altogether for the remedial class waiting for my arrival right after the class of Science. I entered the classroom and greeted them before they did. At first, I divided them into different groups of 2, 3 and 4 with reference to their choices, provided that I was conscious enough to adjust each of the weak ones with the smarter ones. As per their demand, I planned to teach factorization of algebraic expressions. Before starting the class, I randomly asked them the basic Algebraic formulae and wrote the ones which were necessary for that day.

1. $(a + b)^2 = a^2 + 2ab + b^2$
2. $(a - b)^2 = a^2 - 2ab + b^2$
3. $a^2 - b^2 = (a + b)(a - b)$

Moreover, I was not going to teach how these formulae could be re/contextualised because it was already taught in the regular class. More than re/contextualising the problems, I felt that they had difficulties in algorithmic problem solving. That's why; I directly began my class with factorization of algebraic expressions.

At first, I asked them if they knew about the perfect square numbers. Most of them could hardly say the squares of the numbers up to 11. I wrote the perfect square numbers at the right side of the whiteboard and gave five questions.

Factorize: 1. $x^2 - 4y^2$ 2. $1 - 25a^2$	3. $3m^2 - 12n^2$ 4. $18x^3 - 50xy^2$ 5. $81\ p^3q - 169pq^3$	$1 = 1^2$; $4 = 2^2$; $9 = 3^2$; $16 = 4^2$; $25 = 5^2$; $36 = 6^2$, $49 = 7^2$; $64 = 8^2$; $81 = 9^2$; $100 = 10^2$; $121 = 11^2$; $144 = 12^2$; $169 = 13^2$, $196 = 14^2$; $15^2= 225$; $16^2 = 256$; $17^2 = 289$; $18^2 = 324$; $19^2 = 361$; $20^2 = 400$; $21^2 = 441$; $25^2 = 625$

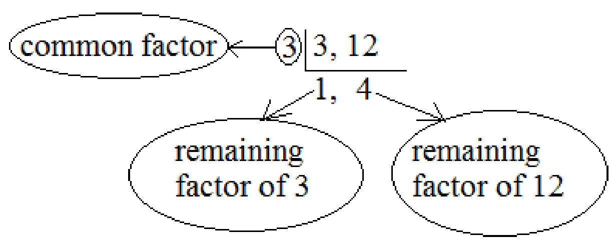
All of the 20 students engaged in solving the problems, sharing their ideas to one other in their respective groups. I kept on moving one group to the other and observed their activities, especially the activities of those who were weak. I kept on interacting with them and asking them if they needed my help. In the mean time, I found a boy making a mistake in taking common in question number 3. I asked him if he knew how to take common factor, but he didn't. I went to the whiteboard and sought for their attention. I taught them what a common factor is and how common factor is taken as follows:

I started to explain the process. "First, find the factors of 3 and 12 …. Here, you can see 3 as a common factor. Take this 3 out of them and write the remaining factors inside the brackets … Remember that there is no any common in the letters m^2 and n^2 and hence inside the brackets they are written as they are along with 1 and 4 … I mean $1m^2$ that is simply m^2 as $1m^2$ and m^2 are same … and $4n^2$ …"

$$3 = 3 \times 1$$
$$12 = 3 \times 2 \times 2 \times 1$$

$$\begin{aligned} 3)\ & 3m^2 - 12n^2 \\ &= 3(m^2 - 4n^2) \\ &= 3\ \{(m)^2 - (2n)^2\} \\ &= 3\ (m + 2n)\ (m - 2n) \end{aligned}$$

I also explained the other possible methods of finding out the common factor. "You can also find the common factor as follows … Here, 3 is the common factor … 1 is the remaining factor of 3 and 4 is the remaining factor of 12 …"



In this way, I gave some examples of how common factors could be found out. More so, they had no problems in finding out the common factors from letters, for example, as in question number 4, i.e. in the expression $18x^3 - 50xy^2$, they were able to take x as a common factor. After they solved all the five questions given on the whiteboard, based on the "assumptions of behaviourism that if teachers speak clearly and students are motivated, learning will occur; and if teachers act in a certain way, students will likewise act in a certain way" (Wilson, S. M., & Peterson, P. L., 2006, p. 2), I added some more examples so that the repetition of the similar type of activities could change their behaviour and learned what I intended to teach them. In the mean time, the Schubert's (1986) curriculum metaphors were also spinning in my mind.

Most probably, I was much influenced by the curriculum as intended learning outcome which was guiding my pedagogy so as to teach my children to achieve what I intended. I was happy because my learning objective was fulfilled at that very moment and the students were improving their procedural skills. More so, I was also sincere about using one-size-does-not-fit-all pedagogy and critically examining why earlier in my pedagogical voyage I was not conscious enough to notice that one-size-fits-all pedagogy would not work at all in the mixed ability classroom.

As I mentioned earlier, I re/visited different literatures such as the local literatures of Luitel (2003, 2009, 2017), Pant (2015), Thapa (2016), Poudel (2016), Gautam (2017), and Shrestha (2011) and tried my best to link this classroom context to those found in the literatures. I also revisited my previous chapters, especially chapter III, in which my inquiry envisioned mainly three possible major factors influencing the students' learning of mathematics in the mixed ability classroom: *culturally decontextualised curriculum*, *disengaged pedagogy* and *sit-for-test assessment system*. However, I also realised that I was limited to fulfill the objectives of the curriculum which, in turn, guided me all the way to follow the one-size-fits-all (disengaged) pedagogy so as to prepare my students in a sit-for-test exam, despite knowing the fact that my trouser cannot fit for all the members of my family.

Nevertheless, as a professional teacher I could not take it as an excuse and leave it as it is by just blaming the curriculum. I needed to work out … I needed some way out … I recalled the Tomlinson's (1999) "The Differentiated Classrooms" and visited it again and again to seek out the solutions of my problems. I was struck by the Hallmarks of the Differentiated Classroom: "In differentiated classroom, teachers begin where students are, not the front of a curriculum guide (p. 2)". Therefore, realizing that blaming game would be just my escape mechanism from the real problems of students' learning of mathematics, I critically re-examined my pedagogical practices and began to engage my students through different learning modalities: studying students' varied degrees of complexity, tempting to different interests of students, probing their abilities and learning patterns, and many possible attributes of students such as their beliefs, values, attitudes and emotions towards mathematics.

In this regard, I internalized that the task of differentiated instructions was very much challenging for me to implement in the mixed-ability classrooms. I had to unlearn the way I had been teaching mathematics in such classrooms. As mentioned earlier, I had to transform both of my ways of being and becoming. Nevertheless, I had to perform it and hence comprehended that I had to employ the 'praxis-oriented pedagogy' so as to address every student in the classroom. As a praxis-oriented teacher, I performed thoughtful examination of taken-for-granted assumptions and began to act on my emerging critical consciousness so as to change my practices (and systems) that routinely disadvantaged my students (Tutak, Bondy and Adams, 2011). After all, I was able to prepare myself for taking the challenge of improving my (so-called) weak students.

Regarding the remedial classes, it took me three months to groom all the students and I was able to transform their actual level of development to their potential level of development. I mean, their actual level of Grade 6, 7 and 8 was transformed into their potential level of Grade 9 using Vygotsky's zone of proximal development. For this, I taught them individually as well as in groups; employed pair-learning, collaborative and co-operative learning; encouraged them to solve the problems on the whiteboard; talk to them individually and counseled them; in some cases, I was tough for them too when they tried to cheat me while doing the problems in the classroom and also sent them to the Principal's office for not doing their homeworks; I called their parents and interacted in a regular basis; once I realised that they were enjoying doing problems of mathematics, and that they were able to learn mathematics as intended, I began to make some fun in the classroom such as singing, dancing, acting funnily, asking them to sing songs, telling jokes, etc. However, during the three months of time, I found that the major weakness of my students was on 'posing the question' to the teacher in the classroom, which I gradually erased from their heart and mind. Now, they are much more inquisitive to know the answer of 'how' and 'why' instead of just being objective to know the answer of 'what' in the classroom.

Referring to what Tomlinson (1999) said "Teachers can differentiate content, process, and/or product for students.", I first differentiated the 'contents' for the differentiated instruction. For this, I categorized the students by giving different types of factorizations of different skills. For example, right after teaching the five questions, I gave the mixed types of expressions which could be factorized using the formulae of $a^3 + b^3$, $a^3 – b^3$, $a^2 + b^2$ and mid-term factorization method. I sincerely observed their engaged learning activities. For this, I, moreover, employed differentiated instructions with differentiated processes for differentiated contents in such a mixed ability classroom, thereby obtaining differentiated products at the same time. Albeit it seems to be easy to write these anecdotes here, it was too painful for me to handle the grade while implementing the differentiated instructions: I was exhausted, worn out, and frustrated of being a mathematics teacher. As a professional, however, I, most frequently, oppressed, repressed and/or suppressed my emotions and then consoled my heart and mind so as not to exhibit them while teaching. From this experience, I realised that a (mathematics) teacher should be flexible enough to have his/her emotions towards students and have a strong professional ethics and patience. Otherwise, either the teacher ethically has to quit the job or the students will unethically become his/her victim.

Since then, I comprehended that I should employ the differentiated instructions in the mixed ability classrooms and hence began to implement them in each and every mixed ability classroom as possible as I could. More so, I also helped the teachers of my school how they should handle the students for meaningful learning in the mixed ability classrooms individually as well as by conducting workshops. I reminded them that every individual is different and each individual can have multiple intelligences based on Gardner's Multiple Intelligence (MI) theory. As mentioned earlier in the anecdotes, for the teacher who was asking how to handle the restless student, I suggested her to employ the MI theory for such a kinesthetic learner. For the teacher who was asking how to handle the weak student, and for the teacher who was asking how to handle the students in a diverse classroom, I gave my example of how I handled the weak students of grade IX using the Tomlinson's differentiated instructions.

Being also a University teacher of the course "Recent Paradigms of Mathematics Learning" for the students of Master of Education, I raised in the classroom the issues of teaching and learning of mathematics in the mixed ability classrooms and asked them to have wide discussion in groups. I posed them questions raising different issues when they were having interaction with their mates in their groups. For examples: What do you teach mathematics in a mixed-ability classroom?; Discuss in groups and make lesson plans for teaching 'factorization' in Grade IX in a mixed-ability classroom?; Suppose there are 35 students in a mixed-ability classroom. A few, suppose 10, are those who don't need teacher's support at all, the next 15 need some assistance of teacher, and the rest need full support of teacher while learning mathematics. If you are teaching geometry, choose a topic of Grade X and prepare a lesson plan; etc. Moreover, I also shared my experiences of employing Tomlinson's differentiated instructions in the mixed ability classrooms. I also gave them examples of how I had been employing the differentiated instructions in their classes of 'Recent Paradigms of Mathematics Learning' so that they would connect these experiences to their contexts of teaching mathematics in their schools. For example, a few of them were weak in understanding the concept/theme of the paper because of their poor English language. I divided them into groups so that each group had the students having both poor and higher abilities, instructed them to read the paper individually, and shared their ideas with the group members. I observed their activities very closely with my eyes and ears open and immediately assisted them if they were having difficulties in understanding the concept/theme of the paper or in case their group members were misinterpreting the conceptual meaning.

Above all, I cannot claim that the most frequently heard phrase 'one-size-fits-all' no longer exists in my theory and practice. However, I have realised now that this is the phrase which has been victimizing students for long in Nepal by means of teachers as actors and schools as battlegrounds. I now admit that the opposing phrase 'one-size-does-not-fit-all' pedagogy is helping me challenge the 'status quo' in my pedagogical practices. Moreover, "raising questions about 'the way things are' and wondering how they might be done differently" (Tutak, Bondy, & Adams, 2011, p. 66) have become my habits during my pedagogical practices, so far.

Culturally Responsive Pedagogy: Constructing Good Mathematics Teaching

"Today, we are going to share our narratives of mathematical lessons that have been told or untold to the world." After exchanging greetings, the Facilitator

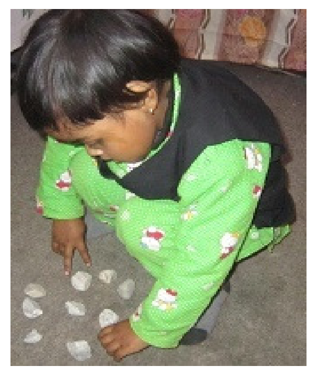
pronounced these words during the MPhil class in 2014. Without welcoming any queries from us, the students, he continued wandering across the classroom, *"It was a long time ago … I was mere a child … I would play with my friends the games such as 'ekalkhutti', 'bagh-chal', 'gotti-khel', etc. One holiday morning, however, I cannot remember much except the chilly clouds passing across the hills of my village and the sun playing hide-and-seek, I along with three of my friends walked down the hills to the seashore so as to collect some pebbles … We enjoyed a lot wandering along the shore, attempted to go into the high current chilly water but in vain because of the fear that the sea might sweep us away to its deeper lap … We had heard from our parents that many were swept away by that deadly sea … After spending about an hour there, we began to collect pebbles of same and different sizes and rushed towards home ... On the way, we encountered with our mathematics teacher who frightened us to nervous-break-down … Yet, he asked us where we were coming from and what we had in our hands and pockets … I dared to speak up and told him about our plan … He was annoyed from the way I uttered words … In response, he spilled out many words of 'dos and don'ts' over us, "Instead of risking your life in the deadly sea and spending time for playing such worthless games, why not you just practice mathematics!" … Becoming the most obedient students of our mathematics teacher, we threw all the pebbles and ran away … However, we did not let go our plan of playing games that day … Once we were sure that the teacher vanished from the scene, we went back and recollected all those pebbles … We planned to gather at a secret place after lunch so that no one would disturb us to play the games …"*

The Facilitator took a long breath standing in front of us and said, *"I now realise how beautifully I was learning mathematics – counting numbers, logical thinking from playing games … That was what my culture of learning mathematics* *which I could hardly experience in schools … I think pebbles helped me learn counting skills … ekalkhutti*[17] *helped me develop my mental and physical ability strong, and bagh-chal*[18] *helped me develop logical and analytical competencies …"*

Finally, he said, *"This much from my side. Will you please share yours?"*

The whole class was quiet and calm. All of us were spellbound from his evocative story, turning the whole class into becoming thoughtful. In the mean time, we began to share ours. Some of the excerpts are as follows:

<ins>Excerpt 1</ins>: *I also would play gotti-khel*[19] *with my friends and sister in my childhood … I would teach my sister the counting numbers using pebbles … I can remember some memorable events when my sister was having problems in counting, adding and subtracting numbers …*



<ins>Excerpt 2</ins>: *I think I had a different experience … In our village, the main professions of the villagers were farming and pottery. Because there was no irrigation facility in our village, we had to wait for summer when the sky would burst and pour rain into the fertile land. In the off season, they would make various types of clay-pots and sell them in the nearby markets. My parents also would*

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[17] The *ekalkhutti* is a local game played by children with one foot. A small flat object such a piece of wood is thrown in a rectangular box partitioned into 8 equal rectangles and is pushed it into another box with a foot jumping with one foot.

[18] The *bagh-chal* (known as "Tiger game") is a strategic, two-player board game that originates in Nepal. The game is asymmetric in that one player controls four tigers and the other player controls up to twenty goats. The tigers 'hunt' the goats while the goats attempt to block the tigers' movements.

[19] The *gotti-khel* is a local game consisting of 5, 7 or 9 pebbles, played between two or more children; *gotti* means pebbles and *khel* means a game.

do the same and I had also learned the skills of making clay-pots of different shapes … I think it helped me learn geometry in school easily …

Excerpt 3: *I am from the remote village, a hilly region of western Nepal … More than 80 % of the people in the village had still not seen and consume the meals of rice grains … They still depend upon corns, millets, sisno (stinging nettle), eiskus (chayote) and the products of animals like sheep and yak, etc … we have different cooking methods … we don't need refrigerator to preserve food stuffs … we make different items of milk products such as ghee, durkha, butter-tea, etc … We use grinding machine which is run by using water flow to grind millets and corns … My father is very expert in building such grinding machines … My mother is expert in making quality durkha from the milk of yak in a special wooden drum called shoptu in local language … I learned counting numbers very easily in my local language because we had numbers of sheep and yaks in my childhood … However, we have gradually left our profession after my elder sister and brothers came to Kathmandu for their higher studies and worked here thereby raising our livelihood … I had never learned such cultural mathematics in school to till date …"*

Excerpt 4: *My father was a gardener in India when I was a child … In fact, my father migrated to India for the search of earnings as our economic condition was disastrous at that time before I was born as my parents told me ... My father was just of 18 years when he left home in Nepal for India … He struggled to earn his livelihood out there … Finally, he found a job of gardening in Punjab … Later, he married a Punjabi girl, my mother, and I was born as a first and last child of the family … My father started his own business in support of my mother and gradually became wealthy … When I completed my matriculation there in Punjab, India, my family came back to the village in Nepal and build a house where we live with our* *grandparents and the family of uncle. I completed my higher studies up to BSc here in Kathmandu … I still remember how my father would take me to the garden and teach me the skills of gardening … I learned different skills of beautifying the gardens … My father was expert on sorting out the different shapes of flower beds. He was also skillful in matching the colours so that he would bring different flowers of matching colours in the garden … Now I realise that the thinking process of my father in selecting the matching flowers and making different geometrical shapes of the flowerbeds … I still remember how he had done some creative works such as writing 'WELCOME' on the flowerbed, 'NAMASTE' using tree branches and bushes … The landlord was very happy with his hard work, dedication and creativity. That's why; as my father told me, the landlord arranged a Punjabi girl as my mother for my father from the village … My mother always encouraged me to learn the values and ethics of life … Regarding my schooling in India, there was much falvour of contextual problems included in mathematics … I did many project works related to gardening during my schooling …*

<u>Excerpt 5</u>: *My story is similar to social injustices in my village … My father was illiterate but not ignorant, so far as I remember my childhood … My childhood passed experiencing many social injustices that often happened in the village in front of my eyes … I have experienced many uncomfortable incidents in the village … One of them is regarding the land dispute which often happened with my father … Our neighbour would capture our land lawfully with the help of a government officer while my father would resist it. Why not! He would deny giving up the land which he had owned for many years. In response, he would invite another government officer to measure the land and there was a great arguments with the neighbours … More so, I have also experienced the rich people investing their money in higher rates to the*

poor and needy people … The interest rate commonly ranged from 24 % to 60 % per annum, because of which I have seen many poor people selling their land and houses so as to clear their heavy debt, thereby leaving the village for other places … I now realise such happenings of social injustices in my village … Though I learned mathematics in school, to my best knowledge, I could never use that mathematics in raising voices against and solving such social injustices … Maybe I did not learn such mathematics in school …

Excerpt 6: *My father was a carpenter and still he has the same profession … If you need furniture, I can provide you quality furniture items in minimum cost with minimal profit as compared to the market values … My father wanted me to help him in his furniture business but I became a mathematics teacher … However, my father's business helped me in many ways in learning mathematics … It was easier to conceptualize mathematics because I could visualize school mathematics at home … More so, my father's profession has also been helping me in my teaching profession, so far … In fact, I make different teaching-learning materials myself and use them to visualize mathematics in the classroom teaching in my school …"*

Excerpt 7: *I remember an event … I had a classmate from the lower caste. He was very weak in mathematics so that he usually did not do his homework. In response, the mathematics teacher would scold him to the lowest level bringing his low-caste issues … "You are not born to qualify for mathematics learning. You just stay at home and help your parents in making iron pots." Later on, he did not complete his SLC as he left the school while he was in grade seven. Now-a-days, I have also seen such injustices in my school: voices of students from minority are unheard and unaddressed; teachers only focus on so-called smart students and humiliate weak students … Truly speaking, I have hardly found teachers addressing each and every* *student on the basis of their sociocultural backgrounds so that students feel empowered … I think teachers may not have got such knowledge and skills of addressing students' identities that make mathematics learning authentic, so far. I believe that teachers should be able to give students, at least, the sense of understanding the power relationship and structures of social, economic, and civic issues within the local and global context. However, in my case, I always try my best to address such issues and link them to the academic mathematics. For example, I have developed different project works on such issues and encouraged students to present their findings in the classroom using projector.*

Excerpt 8: *I am a Bhutanese refugee … I came here in Nepal along with my family when I was in grade six. In the beginning years, it was a tough time for us to live our lives in Nepal at that time. I was admitted to a nearby English medium school again in grade six. We had so many lived experiences out there in Bhutan which I could not share in school in Nepal as we were indirectly treated as second grade people. Though teachers were friendly but most of the classmates treated me, my brothers and sisters differently so that we had to erase our cultures earned in Bhutan. In Bhutan, we had a profession of beekeeping … It was the main family income source … We had two wheelers and four wheelers … We were rich Nepali family in Bhutan … But our destiny brought us back in Nepal … My childhood in Nepal spent in scarcity of money, food and shelter … Nevertheless, I gradually coped up with the cultures of Nepal and it was not so difficult for us to mix up as we were originally Nepalese. But … those moments we spent before and after arriving Nepal were like two sides of a day – bright and dark. However, I am now a mathematics teacher in a school and quite aware about such issues of the students in the classroom … I try my best to address students' sociocultural issues so that they can have an authentic learning of* *mathematics in the classroom … I tell them my stories without any hesitation and try to link them to the academic mathematics, for example, how beekeeping is harvested, how beehives are made, how honey is collected, and discuss the shape of honeycomb.*

Excerpt 9: *As a teacher educator, I have conducted workshops on Culturally Contextualization of Mathematics Education in my school … I have helped teachers learn to extract cultural capitals of students and link them to the academic mathematics.*

Excerpt 10: *I have now realised that I had knowingly or unknowingly discriminated students on the basis of their learning abilities. Though I would treat them equally, I think I was not able to address my students equitably … Now-a-days, at first, I help students improve their actual level of learning to gain their potential level as possible as I can so that the equity in mathematics learning can be maintained. It was ridiculous when I would teach all the students from the same point of view so that they never learned mathematics as compared to the privileged students … However, it is a very hard task for teachers so as to maintain equity in the classroom … More so, it is also much challenging to balance the power relationship in the classroom because of the students from different cultural backgrounds and having different learning abilities and disabilities … A teacher should have a strong desire and commitment towards his/her profession so as to keep up the equity and power relationship in the classroom …*

Excerpt 11: *I have also experienced that in the English medium schools some students are having difficulties in understanding mathematic. However, I have helped such students learn mathematics by interacting in Nepali language. In this regard, I, sometimes, though I am not expert in their languages, utter the words or sentences of* *their mother languages such as Bhojpuri, Maithili, Newari, which, I have observed, has increased their positive attitude towards me and mathematics learning …*

Excerpt 12: *From this sharing of stories, yet I am realizing that mathematics teaching should focus mainly on three objectives: First, it should help students build on knowledge they bring from outside of school, that is, their cultural capitals; second, it should promote the usefulness of mathematics to interpret the world around them and act on their social issues; and third, it should encourage students understand the usefulness of mathematics for their future studies.*

Excerpt 13: *Of course, you are right, friend! Teachers must realise that mathematics teaching is a political activity rather than neutral activity, because it helps students develop an awareness of the role of power in school policies and curriculum practices and encourages them to raise their voices against unhealthy practices and inequities in mathematics education.*

Excerpt 14: *It means that mathematics learning is based on prior knowledge and experiences and it is a complex, non-linear and meaning-making process. A mathematics teacher has to play an important role of bridging between the prior knowledge and new knowledge.*

Excerpt 15: *I think a mathematics teacher should acknowledge students' cultural capitals and use them in the classroom to maximum advantage. In my opinion, parents should also be invited for guest lecture because families and communities have knowledge, skills and experiences of mathematics that can be beneficial for mathematics teaching and learning.*

Moreover, the Facilitator had already assigned us to go through the key reading materials of the course last week. That's why; that day all the students' narratives were oriented to the work of Aguirre and Zavala (2013), which is about culturally responsive mathematics teaching. The Facilitator was very happy to see his students actively sharing their narratives based on the prescribed paper during the classroom discourse. Finally, he put some light on our narratives and highlighted the key concepts of the paper by connecting them to the contextual examples of our everyday life-worlds, and concluded the class.

Throughout my MPhil study in KUSOED, I gradually got insight of ‘good mathematics teaching’. Moreover, in due course of my pedagogical journey, I was always inquisitive to learn various effective methods of teaching mathematics because I had already begun to experience that “today’s classroom is more complex and dynamic” (Larrivee, 2000) as compared to the classrooms of those days when I just started my journey of teaching. Based on my experience, people from across the nation in Nepal are migrating to the urban areas for their better and safe life because of the various political conflicts occurred due to the reestablishment of democracy. Therefore, today’s classrooms are increasingly becoming multicultural; students from different socio-cultural backgrounds are mixed up in the same classroom and yet, teachers are not well-prepared to address students’ academic, social, cultural and emotional needs so that they are alienated from an authentic learning of mathematics. In this regard, I as an MPhil student got equitable chances of sharing my experiences of mathematics teaching and learning in the classroom discourses and so did all of my friends because of the Facilitators at KUSOED. For example, the above excerpts of the narratives shared by the MPhil students during the classroom discourse demonstrate that teaching and learning are associated to social discourse, and “meaning, thinking, and reasoning are products of social activity” (Valero, 2004).

I have now realised that for teachers, only accumulating knowledge, skills and strategies of teaching is not sufficient for the meaningful learning of mathematics in the classroom; rather teachers should be able to employ culturally responsive pedagogy through which students' cultural capitals are well addressed in the classroom. Based on Aguirre and Zavala (2013), culturally responsive mathematics teaching is a set of specific pedagogical knowledge, dispositions, and practices that privilege mathematical thinking, cultural and linguistic funds of knowledge, and issues of power and social justice in mathematics education. Moreover, Moll and Gonzalez (2004) used the term funds of knowledge to refer to the knowledge base that underlies the productive and exchange activities of households (p. 700). I believe that such funds of knowledge incorporate knowledge from broader social contexts and hence can be the resources for teaching and learning of mathematics. In this regard, teachers needs to be much aware of such funds of knowledge that demonstrate how family activities, for examples, gardening, sewing, scheduling, cooking, and playing games are mathematical resources available to the students and teachers to support mathematics learning of children (Civil, 2007). Not only that, such funds of knowledge also include the community mathematical practices occurring locally to contextualize and extend conceptual understanding of mathematics (Luitel & Taylor, 2007).

Moreover, being a transformative research-practitioner, after the above sharing discourse of narratives in the MPhil grade, my ways of knowing grew even wider enough to envision such mathematics education that incorporates the contextual mathematical resources exploring the mathematical practices of students such as household activities and professional activities. In the mean time, I became more thoughtful regarding my pedagogical practices and hence some issues were raised in my mind: Do the existing curricula of school mathematics in Nepal incorporate such cultural capitals of students? How would I incorporate students' funds of knowledge so as to employ the culturally responsive pedagogy in the classroom? Can I construct good mathematics teaching for meaningful, authentic and inclusive mathematics learning in the classroom?

Despite many challenges, I have begun to employ culturally responsive teaching in the classroom as possible as I can. However, it is not as simple as scholars and researchers convey because mostly the researches on culturally responsive mathematics teaching e.g. Aguirre and Zavala (2013); Moll and Gonzalez (2004); Valero (2004); (Civil, 2007); (Luitel & Taylor , 2007), etc. demonstrate that the mathematical resources should be re/contextualised on the basis of students' cultural capitals which are not incorporated in the existing curricula of school mathematics, so far, because of which teachers are bounded to fulfill the objectives of culturally decontextualised mathematics curricula, thereby subordinating or/and neglecting the students cultural capitals. Nonetheless, I am now conscious enough about the culturally responsive pedagogy and its advantages, and attempting to leverage the students' funds of knowledge to construct good mathematics teaching during my pedagogical practices.

Critical Pedagogy: Empowering Myself and My Students

Since I was much fascinated from the critical pedagogy that I learned during my MPhil study, I was much eager to practice it in the classroom. I don't deny now that theoretical knowledge that I got from the course was sufficient to sharpen my pedagogical skills, rather it would not be fruitful unless I implement it during my pedagogical practices. However, for becoming a critical teacher, there was a huge challenge while selecting the contents that would fit into the curricula and address what Tutak, Bondy, and Adams (2011) asserted, "Raising questions about 'the way things are' and wondering how they might be done differently are the habits of those who embrace a 'critical' approach to education" (p. 66). Moreover, before teaching the issues of equity and social justice using critical pedagogy, I should be able to challenge the status quo, that is, my own and my students' well-established ways of thinking that frequently limit my own potential and my students' potential as well.

In this regard, becoming an enthusiastic critical learner, I spent about a week to prepare the plans for teaching mathematics in my school, keeping in mind that critical pedagogy is not a one-size-fits-all pedagogy but a humanizing pedagogy that values students' (and teachers') background knowledge, culture, and lived experiences (Bartolome, 1996), moving students (and teachers) into their own ever-expanding interpretations of their lived worlds (Greene, 1996).

It could be the month of January 2015 as I still remember the news about the celebrations of New Year 2015 from across the world being broadcasted by the television and newspaper, and my family was also the ones celebrating the English New Year, though our new year generally falls on the month of April. Finally, I began to implement my plans in my school for grades IX and X. Here are some anecdotes which portray how I as a critical teacher-learner implemented critical pedagogy in the classrooms:

<u>Anecdote 1</u>: "Dear students, today I am going to assign you a project work based on the lesson 'Set'. Please, read this paper and ask if any queries."

I distributed the papers to all the students. The project work was designed as follows:

Project Work

Grade: IX **Compulsory Mathematics**

Duration: 1 Week

Conduct a survey of about 50 people in your community to find the people who like to drink tea, coffee, both or neither of them. Make a frequency distribution table as follows and keep records of all data:

Items	Tally Marks	Frequency
Tea		
Coffee		
Both tea and coffee		
Neither tea nor coffee		

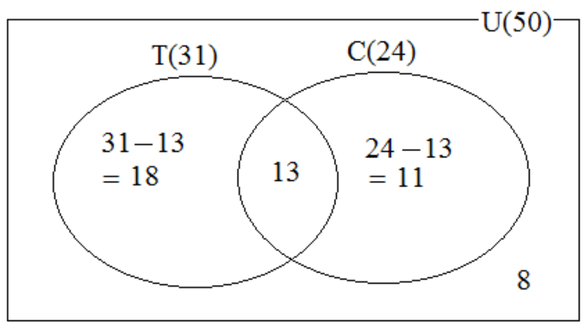
Represent the above information in the Venn diagram.

Note: While approaching the people in the survey, greet the people first, introduce yourself and explain, in short, the purpose of the survey so that you would be able to collect the correct information from the people.

Next week, I asked them to be ready with their project work on the desk. Out of about 30 students in the classroom, I found a few (perhaps 4/5 students) without their project work. After inquiring and suggesting them to submit their project work next time, I asked all the students to share their experiences of conducting the survey. After that, I said, “Now I am going to take one project work from you and discuss widely about the data using Venn diagram …Umm … Who gives me the project work?” They were quite for a while, but a boy stood and handed over his project work. I wrote his data on the board:

Items	Tally Marks	Frequency
Tea	~~////~~ ~~////~~ ~~////~~ ~~////~~ ~~////~~ ~~////~~ /	31
Coffee	~~////~~ ~~////~~ ~~////~~ ~~////~~ ////	24
Both tea and coffee	~~////~~ ~~////~~ ///	13
Neither tea nor coffee	~~////~~ ///	8

After writing the above data, I discussed the information collected in the table. In the mean time, I said, "What is the total of all the frequencies?" They used calculator and said, "76, Sir." I immediately said to the boy, "With how many people did you conduct the survey?" He said, "50, Sir!? I said, "No, you surveyed 76 people … You must be telling me a lie! Otherwise, how came the total 76 here in your record?" All the students were astonished. I said, "Can anybody explain why it is 76 as total though 50 people were surveyed?" The whole class began to look into one another, whisper and chant. No one could reply. I said, "Hold on the class, please! Leave it for now. Probably, you will understand from Venn diagram. Let's go for it."



After drawing the Venn diagram on the basis of the project work (which he had done correctly), I posed a question, "Now, study the information distributed in the Venn diagram and tell me how you find the total number of people surveyed." They knew it as they had already learned the procedures in the previous classes. They said, "18 + 13 + 11 + 8 = 50" I said, "Very good. Now discuss each other with your friends why the total is 50 but not 76." I allowed them about 5 minutes for discussion. The boy (whose project was taken by me) and a girl raised their hands. At first, I allowed the girl and then the boy. Both the boy and girl explained correctly that 13 people are those who like both tea and coffee and they are repeated twice in tea and coffee. Finally, assigned them the following questions as homework and asked them to submit the solutions along with their project works.

On the basis of the information in the Venn diagram, find the number of people who like:(i) both tea and coffee, (ii) only tea, (iii) only coffee, (iv) only one drink, (v) neither of them.

Anecdote 2: “Dear students, I am going to assign you a work.” I said to the students of grade X exhibiting the papers, “Here are two papers. In the first paper, you can find the salary sheet of public school teachers which I retrieved from the internet and you can find the instructions and the questions in the second paper. Moreover, I have designed two activities. For this, I am going to divide the grade into groups and you will discuss with friends in group to find out the solutions of the given questions. For more information, please go through the papers.”

I divided the class of 34 students into six groups and distributed the papers. I assigned them five minutes for reading the papers and explained explicitly about the activity they had to do in group work.

The school education system in Nepal consists of primary, lower secondary, secondary and higher secondary education. Starting from Grade one, primary schools offer five years of education, lower secondary schools provide further three years of education (6-8), and secondary schools offer further two more years of education (9-10) which concludes with the School Leaving Certificate (SLC) Examination. While higher secondary schools offer two more years of education after SLC. In addition, Early Childhood Development (ECD) /Pre-primary Gradees (PPCs) are offered as preparation for Grade one. Broadly, schools are categorized into two types: community schools (supported by government of Nepal) and institutional schools (supported by parents and trustees). Community schools have three sub-categories: community-aided (fully supported by

the government for teachers' salary and other expenses), community-managed (fully supported by the government for teachers' salary and other funds but their management responsibility lies with the community) and community-unaided (getting either partial or no support from the government).

The table below gives information regarding salary of teachers which is given by Government of Nepal (Effective from Sharwan, 2073). This salary may not represent the salary of teachers in Boarding schools and other community managed schools.

Level	Post/Eligibility	Salary per month
Primary	Failed SLC in more than two subjects (grade 6)	NPR: 20,674
Primary	Failed SLC in two subjects (grade 6)	NPR: 22,066
Primary	SLC Passed (grade 6)	NPR: 26,604
Primary	SLC Passed (grade 8)	NPR: 29,764
Primary	SLC Passed (grade 8)	NPR: 38,636
Lower Secondary level Teachers and their salary in Nepal		
Lower Secondary	Lower secondary (grade 8)	NPR: 29,764
Lower Secondary	Lower Secondary (grade 8)	NPR: 38,636
Lower Secondary	Lower Secondary (grade 8)	NPR: 40,660
Salary of Secondary Level Teachers in Nepal		

Secondary	Secondary (grade 8)	NPR: 38,636
Secondary	Secondary (grade 8)	NPR: 43,348
Secondary	Secondary (grade 6)	NPR: 48,178

Note: Teachers who were recruited ahead of 2057-04-01 and who are teaching technical subjects enjoys two extra classes and their salary is slightly higher than mentioned above.

Activity One:

Discuss the following questions each other with friends in your respective group and find the solutions:

1. Find the average monthly salaries of primary, lower secondary and secondary level teachers.
2. Find the average yearly incomes of primary, lower secondary and secondary level teachers.
3. Find the median monthly salaries of primary, lower secondary and secondary level teachers.
4. Find the median yearly incomes of primary, lower secondary and secondary level teachers.
5. Represent the monthly salaries of primary, lower secondary and secondary level teachers in separate pie charts.

Note: Each group will share their findings in the classroom tomorrow.

Activity Two:

Discuss the following questions each other with friends in your respective group here in the classroom. Later on, you take this project work home and ask your parents and people in your community and write your arguments:

1. Do you think that the government has done justice to the teachers of all levels

from the salaries? Write whether the salary is sufficient to run their family of six members (husband, wife, their two children and parents) at the present situation of Nepal.

2. What sorts of issues and problems would be raised in the cases of the people living in the urban, suburban and rural areas if they have to depend on their salaries?

Note: Share your findings in the classroom next week.

<u>Anecdote 3</u>: “Dear students, today I am going to assign you some works. As you know that our course was already finished and we are revising the course for the upcoming SLC examination. I hope you understand and cooperate with me. So, today’s topic is ‘Teach your friends to teach yourself!’” I wrote it on the whiteboard. All the students of grade X were astonished. They shouted, “What does it mean, Sir?” I said, “I will select ten teachers from you and assign one topic for each of them today. They will get one day today to prepare on the specific topic and teach their friends tomorrow. For the next time, again the remaining students will be selected as teachers accordingly so that no one will be left behind.”

I rolled my eyes to all the students and tried to read their gestures. “Who are those ten smart boys and girls for this project? Come on, tell me!” No one was ready. However, I explained them why it is important for them, how sharing of knowledge multiplies their knowledge, and how it helps them build up their confidence and increase their retaining capacity. I said, “You are comfortable with your friends while sharing your knowledge and can raise questions freely without any hesitation. Today, I will select ten teachers from you and allow them to select at least two students. The students should also prepare themselves so that they would be able to ask questions to their respective teachers.” I waited for their response but no one was ready and hence I had to do the selection. I selected the top five boys and top five girls of the class and asked them to select at least two students. Out of 35 students, I adjusted the remaining students to any five of them. Finally, I asked them to discuss each other for the selection of the topics.

I ran this project for about a month. I always observed students' activities very closely and encouraged them for their active participation. They approached me asked question in case of any problem in understanding and solving the problems. Later on, I found out that they were very active to share their knowledge and ask questions to anyone in the classroom. However, there were some dispute between some students because of the 'girl's issue', which I immediately resolved. I knew that there were some social issues of power, identity, class, gender, race, caste, ethnicity, learning ability/disability, regions, etc. in the classroom because of the existing transitional political situation in the country. I had found some of them discriminating their classmates. However, I found them respecting each other because of that one month long activities. More so, everyone improved their academic performances in the Secondary Education Examination (SEE) and produced unexpectedly the better result as compared to the previous years.

The above three anecdotes portrayed how I attempted to implement critical pedagogy in teaching and learning of mathematics in the classroom. I think I was much aware about the social justice, racial justice and economic justice that should be addressed by mathematics education, and for this a teacher should be a critical teacher. However, I am now pretty aware about the fact that being critical is not being negative; rather critical teachers are committed to democratic principles of justice and equity. More so, I am also conscious about the fact that critical pedagogy supports a problem-posing pedagogy in which *subjects* who know and act – in contrast to objects which are known and acted upon – develop their power to perceive critically the way they exist in the world with which and in which they find themselves (Freire, 1970). That's why, through the lens of critical pedagogy, I always find myself as a critical teacher prepared for empowering myself and my students during my pedagogical practices, thereby challenging my and students' *status quo* in teaching-learning process of mathematics.

Key Message of the Chapter

In this chapter, I as a transformative research practitioner presented four narratives to portray how my pedagogical sensitisation towards mathematics helped me envision a holistic way of teaching and learning through transformative education. Being a novice transformative research practitioner, I tried my best to examine and critique disempowering structures arising from and associated with my personal and professional lifeworlds so as to develop empowering and inclusive visions for my present and future pedagogical practices, thereby committing to transform mathematics education policy, curricula and/or pedagogical practices within my own institution (Taylor, Taylor, & Luitel, 2012).

Based on the above four narratives, I confess that my process of transformation is on in my pedagogical practices due to transformative education research. Moreover, I attempted to bridge between logos-oriented reductionist pedagogy and mythos-oriented holistic pedagogy, thereby learning to address the values of both pedagogies so as to establish the relationship among mathematics, self and culture. I used the principles of one-size-does-not-fit-all pedagogy to challenge the *status quo* in my pedagogical practices as well as in my students' learning of mathematics in a mixed-ability classroom by addressing, so far, the norms and values of multiculturalism. I learned how culturally responsive pedagogy help mathematics teacher construct good mathematics teaching through social discourses. Moreover, I became aware about the fact that meaning, thinking, and reasoning are products of social activity. That's why; I have already begun to use culturally responsive pedagogy by addressing students' academic, social, cultural and emotional needs, for which I always attempt to leverage students' cultural capitals in the classroom for their meaningful and authentic learning of mathematics. Finally, I have now become a critical teacher, so far and begun to use critical pedagogy in empowering myself and my students through mathematics education. I have now pretty aware about raising the questions about the way things are and wondering how they might be done differently and shaping my pedagogical skills to its finest form so that I would be able to address the issues of social justice and equity in mathematics education.

Orienting to all the above confessions of my pedagogical practices, I find myself as a sensitised pedagogue towards holistic mathematics education through transformative education.

CHAPTER VI

MY LEARNING AND REFLECTIONS

This is the concluding chapter of my research report. Therefore, this chapter reveals, in brief, my research journey and what I explored after the accomplishment of this research study. Throughout the chapter, I have reflected on my research journey and presented what I have learned after conducting this research study. More so, I believe that learning cannot be described by limiting us to a single word, a single phrase, a single sentence or a single paragraph. The readers can find what I have learned after conducting this research study from the beginning of this chapter till the end. In this regard, I have begun the chapter with my reflections on my research journey followed by Reiterating My Research Aims, Implications for Others and Myself, and My Future Directions.

Reflecting on My Research Journey

As a human being first and then a professional mathematics teacher, teacher-educator and practitioner-researcher, I believe that there are enumerable moments in our life, some are chewed and digested, some are still soaked in saliva, yet to be swallowed, and a few comes into mind as flashes and trembles our heart and mind, pauses our veins and nerves, and opens a new window to get into memories, where we seek our pertinent files and documents that explore our past to exercise our present and shape our future. This is how our *rita-like* life has been in this beautiful world. When I peer into my professional life as a mathematics teacher, many of my painful moments that I suffered from and many of my graceful moments that I was amused by come into my mind now and encourage me to unfold to the world. Moreover, both suffering and amusement, after all, persuaded me to continue my educational journey and encouraged me to join MPhil study as soon as possible.

Drawing on my master's research (Shrestha 2011), my future direction was to become an empowering mathematics teacher, and to continue my study till PhD in mathematics education. However, I could not join MPhil right after the completion of my master's study as KUSOED had no MPhil programme in mathematics education at that time, and upon suggestion of the programme head, I had to wait till 2014 for the enrollment. Until then, I just focused on improving my pedagogical practices and kept on my passion of teaching mathematics in schools and educating mathematics teachers.

During the tenure of pedagogical voyage, I came across many challenges that enforced me into vulnerable situations, thereby worsening me to the state of frustration, irritation, annoyance, and exasperation from the profession. Moreover, mathematics teaching has increasingly become a challenging profession because of increasing aspirations of students and parents. However, being a professional teacher, I could be able to counsel and console myself and tried to seek into the brighter part of the 'teaching profession'. Nonetheless, I had the brighter side of my professional journey that always came in front of me embracing me so as to hold my position at an equilibrium state of mind. I counted those moments I spent with my students – I reflected and recalled their successes, their respect towards me, their admiration of my loving, caring and passionate ways of teaching; most importantly, becoming the cause agent of turning their almost deteriorated life to a successful life cherished me and saved me from falling behind. Even many students just would remind me about how I transformed to such a teacher from a teacher of having high temperament. In course, I always learned to empathize with students and fit into the profession.

Nevertheless, I am a human being. I have my own personal and family life. At that time, I often found my emotions torn and worn out because of full responsibilities towards my family life besides the professional life. More so, today's classroom is dynamic and complex. More students are coming to school, abused, hungry, and ill-prepared to learn and work productively (Larrivee, 2000). Teachers are not well prepared for welcoming such vulnerable students in the classroom and hence have become an agent of student alienation from mathematics learning. In this regard, I had to update myself every now and then to face the new possible challenges that would arise while dealing with my students in the mixed-ability classroom. Such situation again pulled me back to the same vulnerability. Many rises and falls, gains and pains, successes and failures, and good and bad times came and went by during my teaching profession. Many times, I yelled and cried alone, shouted at myself to reduce my pain and grief, so far.

Why did such vulnerable situations come across my professional life, and why did they reverberate and reverse time and again? Why annoyance, irritation, frustration and exasperation with me? Why my beliefs, values, attitudes, and emotions towards mathematics and mathematics teaching getting deteriorated day by day? Instead of improving my pedagogical practices, why did I always feel that something was pulling me back from moving ahead? What could be the possible factors that were constraining me from becoming a loving, caring and passionate mathematics teacher? Could my personal and family responsibilities and accountabilities be the only reason behind it? Whose interests could be behind it? Who or what would be a change agent for my professional life? How would I find out? How would I triumph over my reverberating and reversible conventional pedagogical practices? How would I improve my pedagogical practices? How would I develop empowering pedagogical skills? These issues and problems gradually build up the foundation of my research study.

Throughout my MPhil study, I learned to learn what I did not learn before. In fact, I learned to advance myself into investigating the issues and problems of my professional life throughout the MPhil course. During the MPhil classes, I often raised many issues about why I could not become an empowering critical reflective teacher so that I would live my professional life in a holistic way. Right after my MPhil study, I had to develop my research proposal. I sat down, chanted myself, became thoughtful and began to unlearn. I sketched all possible problems on my laptop and mapped them to produce some research questions. I deleted some, edited some and generated again new questions. The process of developing research questions continued for sufficient days and nights. Finally, I was able to generate four research questions for my research study. After defending my research proposal, my journey of research study started.

Since research inquiry is always guided by some theories, I chose three big theories – living educational theory, transformative learning theory and knowledge constitutive interests as theoretical referents for my research inquiry (see chapter I). More so, since I had made up my mind to adopt auto/ethnography as research methodology and writing narrative as a method of inquiry, I chose three paradigms – interpretivism, criticalism and postmodernism under multi-paradigmatic research design space. Moreover, I adopted qualitative research method under transformative education research because it addresses all aspects of the researcher, research participants and research field (see chapter II). As I began my research inquiry and writing, I found the last two of the four research questions overlapping each other and hence merged them into one, thereby finally having only three research questions in my hand (see chap. I). However, there was a great twist while researching and writing. Moreover, in the beginning, I had adopted ethnodrama as a genre of writing and completed almost two chapters III and IV. It was too much philosophical missing the sufficient narratives. Since I was in a regular touch with my supervisor Prof. Dr. Bal Chandra Luitel, I sent my chapters to him in a regular basis. He regularly sent me feedback so as to include narratives in the chapters. His constructive feedback regarding the inclusion of narratives was genuine and critical for my research study. In this regard, I visited Pant (2015) many times, which gradually changed my mind for adopting 'writing narrative as a method of inquiry'. In fact, I also needed a new genre of writing narratives other than ethnodrama because I had already employed ethnodrama as a genre of writing in my master's research, and hence finally, I adopted writing narrative as a method of inquiry.

Reiterating My Research Aims

My journey of inquiry began with the excavation of my own biography as a teacher and teacher educator. I generated the research questions on the basis of my history as a conventional teacher, and a teacher-researcher seeking transformation. This autobiographical excavation explored various issues of mathematics pedagogy that teachers have been practicing.

As a conventional mathematics teacher, I explored the possible reductionist natures of mathematics pedagogy and excavated how various disempowering features of reductionism persuaded me to promote linear teaching and learning of mathematics in the classroom (see chap. III, responding to the first research question). The first and foremost purpose of presenting these narratives was to explore how and why I developed the culture of reductionist mathematics pedagogy in my retrospective (before master's study), whereas the second purpose was to explore how and why the reductionist mathematics pedagogy, in general, gives rise to linearity in teaching and learning of mathematics in the classroom. I encountered a number of images of reductionist mathematics pedagogy which are the hegemony of culturally decontextualised curriculum and standardized assessment system in Nepal. I portrayed some of the reductionist natures of mathematics images such as *Pedagogy as/for Sacred Knowledge Transmitter, Pedagogy as/for Finished Product Practitioner, Pedagogy as/for Target Hitter, Pedagogy as/for Bigger Sight Loser, Pedagogy as/for Microscopic Teaching Conniver,* and *Pedagogy as/for Emergent Phenomena Resister*, thereby exploring that a reductionist mathematics pedagogy severely restricts students' opportunities to engage in authentic mathematical thinking and deprives them of the enjoyment of solving richer, more worthwhile problems, which would forge connections across diverse areas of the subject (Foster, 2013).

As a transformative teacher-researcher, I explored how the both linear and nonlinear approaches of teaching and learning of mathematics helped me reduce my pedagogical ecotone and students' learning ecotone. I presented five narratives – *Improve Your Language Skills! Becoming a Language Teacher, Problem Solving or Reproducing Algorithms! Realizing Nonlinear Mathematics, Where Do We Use Algebra? No Benefits In My Whole Life!, Touching the Untouchables: Paving the Nonlinear Path,* and *Look into Yourself! Becoming a Critical Reflective Teacher* (see chap. IV, responding to the second research question). Moreover, the reductionist mathematics pedagogy is due to the hegemony of culturally decontextualised mathematics education in Nepal (Luitel, 2017), thereby increasing the gap between linear and nonlinear teaching and learning of mathematics instead of reducing it. I excavated these narratives from my autobiography to explore the possibilities of reducing such pedagogical and learning gaps so that the hegemony of reductionist nature of mathematics pedagogy can be narrowed down with the inclusion of nonlinear teaching approaches, thereby there would be a 'win-win' situation between the linear approach (which is itself due to the reductionist nature of mathematics pedagogy) and nonlinear approach of teaching and learning of mathematics.

As a transformative research-practitioner, I explored how I became pedagogically sensitized towards mathematics so as to seek for possible ways of living my professional life in a holistic way (see chap. V, responding to the third research question). Moreover, throughout my more than two-decade long pedagogical journey, I have gained enumerable joys and agonies, which could become my strength and weakness of living my professional life in a holistic way. Therefore, as a transformative research-practitioner, I explored the possibilities of transforming my agonies into my strength so as to envision a holistic way of living my professional life in the days to come. In this regard, I portrayed four narratives – *Holistic Pedagogy: Bridging Between Logos and Mythos, One-Size-Does-Not-Fit-All Pedagogy: Challenging the Status Quo, Culturally Responsive Pedagogy: Constructing Good Mathematics Teaching,* and *Critical Pedagogy: Empowering Myself and My Students* to explore the possibilities of how my sensitisation towards both linear and nonlinear teaching and learning mathematics help me envision a holistic way of living my professional life.

Moving away from traditional method of researching (positivist quantitative research) and internalizing multiple realities (ontological assumptions) and subjective knowledge (epistemological considerations), I chose auto/ethnography as a research methodology and writing as narrative inquiry and employed multi-paradigmatic research design space to carry out my research study under which I chose three paradigms – interpretivism, criticalism and postmodernism. These paradigms helped me generate the contextual narratives and to make meaning of them with critical focus using different genres such as storying, poem, pictures. As an ethnographer, I conducted my research inquiry with a prolonged engagement with the research participants in the research field. In so doing, I tried my best to look through other's eye (interpretivism) to empower self and others (criticalism) through a window to look into others' heart and mind (postmodernism).

After conducting the research study, I came to realise that there are number of problems and issues on the use of both linear and nonlinear teaching and learning of mathematics in the mixed-ability, multicultural classroom in Nepal. Despite teachers habituated with linear teaching approaches are ready for employing nonlinear teaching of mathematics in the mixed-ability classroom, there comes the hegemony of culturally decontextualised mathematics curricula, reductionist mathematics pedagogy, and standardized assessment system. Moreover, the hegemony of culturally decontextualised mathematics education is not able to encourage teachers to implement empowering mathematics pedagogy in meaningful learning of mathematics. Students are daily enforced directly and/or indirectly for engaging themselves in 'practice method' of learning mathematics so that they will be able to score better marks in examination. Even the parents have misconceptions that mathematics is all about calculations and practice method is only the way of achieving better marks so as to score distinction (A grade) in mathematics. More so, school is also found putting its all effort to produce better result in the SLC (SEE) examination so as to get the certificate of 'A' grade school. Orienting to these issues and problems, I have realised that there are still more to do to promote non/linear teaching and learning of mathematics in schools and it needs more research inquiry so as to find out ways of implementing such empowering mathematics pedagogy in the classroom. Above all, after the accomplishment of the research study, I learned to learn what I did not learn before; I learned to learn how to learn to transform ways of knowing, ways of being/becoming, ways of valuing and ways of sensing; and I learn to learn how to envision holistic mathematics education despite many challenges.

Implications for Others and Myself

Every research study has its purpose and some implications to others as well as to the researcher himself/herself. I agree with Luitel (2009) that if I do not speak about possible implications for others …, I may be termed as narcissistic who is overly concerned with his own self-pride and self-interest (p. 383). Therefore, to get rid of becoming self-observed and selfish, I confess that my research study has certainly implications to myself, the mathematics education community, curriculum committees, teachers, teacher educators, students, students and schools.

In effort of constructing vision of developing my pedagogical sensitisation towards holistic mathematics education through transformative education, I came up with number of disempowering images of reductionist mathematics pedagogy such *Pedagogy as/for Sacred Knowledge Transmitter, Pedagogy as/for Finished Product Practitioner, Pedagogy as/for Target Hitter, Pedagogy as/for Bigger Sight Loser, Pedagogy as/for Microscopic Teaching Conniver,* and *Pedagogy as/for Emergent Phenomena Resister*. While conceiving such disempowering features of reductionism, I realised that the hegemony of reductionist mathematics pedagogy is prevailing in the classrooms in Nepal and has been promoting linearity in teaching and learning of mathematics in Nepal, and especially, students have become victims of linear way of learning of mathematics, thereby creating huge space between linear and nonlinear ways of students learning of mathematics and hence preventing them from meaningful learning of mathematics in the classroom. More so, it has also created spaces between the linear methods and nonlinear approaches of teaching amongst mathematics teachers.

Nevertheless, there could be possible ways of reducing and/or completely eliminating such spaces created/being created between linear teaching and learning of mathematics in Nepal. While conceiving the nonlinear natures of teaching and learning of mathematics, I came to realise that it is possible to implement both linear and nonlinear approaches of teaching and learning of mathematics in the classroom, provided that the culturally decontextualised mathematics curriculum should be revised and reformed gradually to reduce its hegemony in the field of mathematics education in Nepal. More so, a teacher can be sensitized pedagogically after adopting the non/linear approaches of teaching mathematics so as to give rise to empowering, inclusive and authentic learning of mathematics in the classroom, thereby helping himself/herself live his/her professional life in a holistic way under transformative education.

Indeed, what I have articulated as possible implications for others can also be implications for my future pedagogical practices as well because I am also the ‘other’ – a teacher, a teacher educator and a researcher. Besides, the disempowering features of reductionist mathematics pedagogy that I have identified will be my key orienting elements in pushing me forward to envision for ‘good’ mathematics teaching for the ‘good’ of my students and myself.

Besides, in the chapter II, I have mentioned my multiple research logic and genres such as hypothetico-deductive, dialectical, metaphorical, poetic and narrative logic and genres. I hope to employ these logic and genres for re/conceptualising my personal and professional practices, thereby becoming more conscious of what I think about how I act my roles as a teacher and teacher educator. I hope to use hypothetico-deductive logic and genres in its mild form to identify the *rita-like* nature of my pedagogical practices so as to make balance between both *rita-like* and *lila-like* natures of my personal and professional life (see chap. I).

I also hope to employ dialectical logic and genres to develop a dialectical relation between the linear and nonlinear dualisms of teaching and learning of mathematics. More so, I envision that dialectic logic and genres can help me illuminate my complex positionality as a teacher and teacher educator who needs to co-act and co-perform according to competing interests and ideologies. Born and grown up via eastern wisdom tradition, I have realised that the hegemony of western wisdom tradition is prevailing in education. I hope to employ dialectical logic and genres to transform the hegemonic western wisdom tradition to establish a healthy dialectical relationship with eastern wisdom tradition so that I can interact with the people locally and globally to make meaning of the world.

I hope to employ metaphorical logic and genres in articulating my present and future personal and professional practices beyond the traditional hegemony of literary thinking, acting, representing the world. More so, I hope that metaphorical logic and genres will help me articulate a multilayered view of self and other by emphasizing the assumptions that life is full of metaphors that help people understand and represent complex things explicitly. More so, poetic logic and genres can help me in articulating ineffable dimensions of my actions which may not be portrayed through the rigidity thinking of hypothetico-deductive logic and genres. Having grown up through eastern wisdom schooling, I have lived poetic life and hope that the poetic logic and genres will help me in reaching into the ineffable of people with whom I deal in my personal and professional life. Finally, I hope that narrative logic and genres will help me interacting with the people around me by reading, listening and interpreting their stories so as to improve my personal professional life. I understand that everyone has their own stories that guide their life and so do I. Through narrative logic and genres, I will excavate the stories of mine and people so as to get insight and develop assumptions for driving my personal professional life forward for the 'good'.

Over all, what I learned from my research study may be complex to express in a single sentence. However, I am much influenced with what Tutak, Bondy and Adams (2011) stated that by raising the questions about 'the way things are' and wondering how they might be done differently have become my habits. Oriented to this notion, I am now aware about the habits of a critical mathematics teacher with transformative sensibilities, who critically re/examines, re/invents and reflects on his own pedagogical practices so as to keep on improving 'self' and 'others'; however, I am also pretty aware of the notion that being critical is not being negative; rather I am committed to democratic principles of equity and justice while teaching mathematics in the classroom.

My Future Directions

Subscribing to my master's research (Shrestha, 2011), I am happy now that I am able to move a step ahead towards my future plan of doing PhD. In fact, I have now completed my MPhil study under the supervision of Dr. Bal Chandra Luitel, who has been my inspiration in the latter part of my educational journey since the time when I did my master's research project in 2011. Despite having many twist and turns, yet, I am not derailed from the track that will take me to doing PhD because of my hard work and determination. My belief in a popular adage "Hard work always pays off!" has always encouraged me to move on towards achieving my aim of life.

In this twenty-first century world, education has taken a giant step towards sustainable developments of people across the world. Being a scholar of mathematics education under transformative education, I have worked in the field of mathematics education in particular and in the field of education in general. I served mathematics education for more than two decades and earned much knowledge and skills of mathematics education. In course of educating myself as mathematics professional, I also got many opportunities of expanding my ways of knowing, ways of being/becoming, ways of valuing and ways of sensing the brighter part of education in general. In this regard, I wish to strengthen my research wider enough to the field that covers wider aspirations of people in the world. I think transformative education research (TER) can be the best for my PhD study in future.

Now-a-days, people across the world have grown with multilayered thinking and acting. Responding to the assumption of reductionist ideology, education demands the integration of various areas of study such as science, technology, arts and mathematics under the TER. In this regard, education is the only tool that can fulfill the multiple aspirations of people under the same umbrella of transformative education. In this regard, I am planning for my PhD degree in TER in which Science, Technology, Education, Arts and Mathematics (STEAM) would be my framework that provides an avenue for how different subjects relate in real life.

Finally, before accomplishing my research journey, I wish to present a poem 'MATHEATICS WHERE ARE YOU?" that portrays a story of a school child who has been victimized by culturally decontextualised 'Mathematics' that is limited in the textbook. The school child is worried about the 'Mathematics' that has been preparing his fellow citizens as human resources for serving in the foreign lands instead of preparing them for his own nation. He requests for 'living mathematics' that exists in his everyday life-world and fits into his soil and cultures.

MATHEMATICS, WHERE ARE YOU?

Mathematics, where are you?

In the school textbooks or in the question paper of the examination!

Since the time I joined the school, I have been searching for you.

I have tried my best, to recognize you from the closest!

But as much I entered deeper into you, so much you became complicated!

By hook or crook, I passed Grade One; however, you came again in Grade Two.

And gradually till Grade X, you came as a giant demon!

From morning to evening, I always worship you at home and school.

Day, week, month and years were spent just understanding you!

But dear Mathematics, I raise a question to you – Where are you?

My teachers have told me – Mathematics is all around us: But where are you?

Because while cooking rice, how much water should be poured – I don't know!

While cooking curry, how much salt is added – I don't know!

After payment in the shop, how much return I get – I don't know!

I have no idea about –

How much carpet is needed in my room!

How much snow of the Mt. Everest melted into water!

How much paddy is grown in the *Terai* region!

How many underprivileged people get access of millet and corns!

Similarly, how long is the border of my country – Nothing I know!

Because I often heard the news that:

Along the border, a Nepali sleeping at night in his/her home

Wakes up in the land of another country in the next morning!

Thus, I ask you – Mathematics where are you?

At this stage, I wish to confess: You are not the mathematics –

That I have heard, understood, and experienced!

Because you are limited in the textbooks, and always scare me in the exams!

You have stolen my beautiful moments of childhood!

Hey, Mathematics! Tell me, where are you?

You are not the Mathematics that I have imagined!

Because you always restricted me in the classroom

To write, draw and memorize signs, symbols, rules and facts!

Therefore, you are surely not the ‘Living Mathematics’ that I am told by my parents!

Because you never taught me the values and ethics of life!

Neither could I understand you, nor did I connect you to my life-world.

Just tell me, Mathematics – Where are you?

Gradually, when I climbed up to the upper Grades,

I was forcefully introduced with strange signs, symbols and names!

I began to learn about the foreign mathematicians –

Pythagoras, Venn, Descartes, Newton, Einstein and so on!

Huh! It’s frustrating!

Where are Nepali Mathematicians! Where is my Mathematics!

Where is the Mathematics of my soil! Where is my cultural Mathematics!

Dear Mathematics! Don’t assume me as a child and don’t make me fool!

Now, I have begun to understand your hidden interests!

You are the Mathematics that prepares my fellow citizens

For serving in the Arabian and European countries, the USA, Australia, etc.

In this regard, certainly I will become a Mathematician!

Thereafter, I will be invited by the foreign nations!

I will be excited to go to the foreign land to serve for the foreigners!

Gradually, I will erase memories of my birth-land Nepal from my heart and mind!

And I will be in dilemma– Which is the better place – Birth-land or Work-land!

However, I will continue to live my life with such fake assumption!

Finally, I will happily live my life in the foreign land, and

Gradually, I will lose my own identity!

Dear Mathematics! Where are you?

Without teaching the values of life, you teach to worship the foreign countries,

You, Mathematics! I dislike you and hence hate you!

However, being a Nepali, born in the birthplace of Buddha,

I believe in peace, prosperity and happiness of all humankinds!

Therefore, dear mathematics! Come transformed!

Though you have finished me and my ancestors,

For the new generations, come as a 'Living Mathematics'

That fits into our soil and cultures!

But don't come just limiting yourself in the textbooks!

Out of the school, come in our everyday life-worlds!

My humble request – Dear Mathematics:

Come as a 'Living Nepali'!

Come as a 'Living Nepali'!

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