PONDERING ON MY BELIEFS AND PRACTICES ON MATHEMATICS, PEDAGOGY, CURRICULUM AND ASSESSMENT

Binod Prasad Pant

A Dissertation

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DECLARATION

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

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Binod Prasad Pant
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December 30, 2015

DEDICATION

This dissertation is dedicated to all mathematics teachers and educators who are thinking for initiating change in each moment in their profession.

Master of Philosophy in Mathematics Education dissertation of Binod Prasad Pant

*was p*resented on December 30, 2015.

Title: Pondering on my Beliefs and Practices on Mathematics, Pedagogy, Curriculum and Assessment

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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 release of my dissertation to any reader upon request for scholarly purposes.

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ABSTRACT

An abstract of the dissertation of *Binod Prasad Pant* for the degree of *Master of Philosophy in Mathematics Education* presented on December 30, 2015.

Title: Pondering on my Beliefs and Practices on Mathematics, Pedagogy, Curriculum and Assessment

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At the time I got into teaching, teaching mathematics was thought to be solving mathematical problems. The deep seated beliefs towards the absolutist nature of mathematics (Lerman, 1986) and the overemphasis on the view as mathematics as a pure subject (Luitel, 2013) in my schooling shaped my teaching to be teacher-centered. Till date after I completed my schooling, I have been fortunate to experience as a student and teacher simultaneously. I was busy in identifying the better tricks, tips and techniques to solve mathematical problems to produce good results in national examination in the initial days of my teaching career. I was highly impressed with the view of "Banking Pedagogy" (Freire, 2000). For this, I deposited lots of "money" in the bank and tried my best to have maximum "transaction" among my "clients". I was also heavily guided by the technical interest as discussed by Habermas (1972).

After joining the Bachelor' degree in Education, I came to know that other pedagogical approaches besides lecture method also existed in the field of teaching.

The use of various manipulatives helped to minimize the gap between school mathematics and students' mathematics. "Mathematical problems are to be solved" was the dominating icon for me. At this time, I believe that I shifted towards the practical interest form technical interest. Joining New Age University for my graduate study became a turning point in my professional life. The classroom discourse and the practices about transformative education challenged my beliefs about the nature of mathematics, curricula, pedagogy, assessment, etc. At this moment, I reflected my long journey of teaching and learning mathematics and I thought unfolding my narratives of my professional life would be a milestone to improve my practices for the rest of my career, and the verisimilitude narratives may make my readers thoughtful about their teaching approaches by reflecting on their perceptions and practices regarding mathematics and its pedagogy. In this context, autoethnography was the best research methodology for me.

The purpose of my research was to investigate and critically asses my beliefs towards mathematics and mathematics teaching, curriculum and assessment. In order to address this purpose, I devised four research questions and chose multiparadigmatic research design (Taylor, Taylor & Luitel, 2012). Interpretivism allowed me to provide substantial descriptive details that are imperative in contextual understanding (Bryman, 2012). The "outward criticality" as well as "internal criticality" made aware with my own practices and the communal strengths and limitations. The use of postmodernism, here, was to draw the multiple genres to capture the narrative in more pragmatic way. I presented my narratives and discussed from the various perspectives to highlight the shift I made on the beliefs and its consequences on classroom teaching. It provided me an opportunity to critically assess my professional journey

and to be aware of the dis/empowering forces that existed within me and the surroundings.

I assessed my beliefs towards the nature of mathematics and came up with such belief systemthat promotes inclusive nature of mathematics (such as dialogical nature of mathematics, Ernest, 1994; humanistic mathematics, White, 1993; im/pure mathematics, Luitel, 2013, cultural nature of mathematics, D'Ambrosio, 1990, 2015). Then, I reflected on my beliefs towards mathematics curriculum, and came up with inclusive and transformative vision for a mathematics curriculum (such as curriculum as currere, Pinar, 2004; Curriculum as montage, Luitel, 2009; curriculum for ecological sustainability and holistic models, Slattery, 2006) in Nepali context. I, then, unpacked my beliefs and practices towards the pedagogical practices, dominant in the field of mathematics education in Nepal, and landed with the critical pedagogy (such as teaching by relfection, Pesci, 2009; teaching for critical understanding, Giroux, 1983; teaching mathematics for social justice, Gutstein, 2006) as a helpful pedagogy for Nepali society. Finally, I critically investiaged my beliefs and practices towards students' assessment, andtried to envisage the better assessment practices (such as assessment is to improve performances, Wiliam, 2011; assessment as enabling power, Wyatt-Smith, Klenowski, & Colbert, 2014) that promote assessment as an inseparable and continuous part of teaching and learning.

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Binod Prasad Pant December 30, 2015

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ABBREVIATIONS

B Ed	Bachelors in Education
CDC	Curriculum Development Center
CERID	Research Center for Educational Innovation and Development
HSEB	Higher Secondary Education Board
KU	Kathmandu University
KUSOED	Kathmandu University School of Education
SLC	School Leaving Certificate
M Ed	Masters in Education
M. Phil	Masters in Philosophy
NASA	National Assessment of Student Achievement (in Nepal)
NCTM	National Council of Teachers of Mathematics
PGDE	Post Graduate Diploma in Education
SSRP	School Sector Reform Plan
GCE	General Certificate of Education

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CHAPTER I

LOCATING MYSELF IN THE RESEARCH FIELD

In this chapter, I articulate my research agenda illustrating my position as a researcher and also as a research participant. I start my journey retelling the event that led me towards such a research agenda. I bring some anecdotes to discuss my underlying assumptions about mathematics teaching and learning by unpacking my personal-professional experiences. While doing so, I describe the context and various threads of my research agenda based on my research focus. I problematize the main issues of my research (nature of mathematics, mathematics curriculum, pedagogy, assessment) and articulate why this problem is worth raising in my inquiry. I discuss how the biographical sketch of my life world as a student, teacher, researcher and teacher educator has given rise to a number of research agenda, and how do I come to land with certain research questions. I further raise research questions and the significance of the study.

Birth of My Research Agenda

"*Sir, you are a facilitator of 'Teaching Mathematics' course. We find it very interesting and personally, I like the way of your facilitation. I know, you are also teaching the students of higher secondary level. I think you apply all the strategies that you know, and your class turns out to be an ideal one. I would love to be in your class to secondary students just to observe how you would engage your students in learning."* One of my M Ed students innocently asked me. It was a day of August, 2010, when I began my teaching career at the university level.

I felt elated getting such a compliment as a novice faculty in the university. I replied with a contented smile, "*I do not think I deliver any utopian class. I have been involving in teaching for the last seven years. I have experiences of teaching students from the primary level to the undergraduate level. Therefore, I try to bring examples and issues from all levels in the course "Teaching Mathematics*". Some of the students like this ingredient of mine. We were in the canteen of the university. As our "consensus break time" got over, we went to the class.

When I reached home, many queries occurred to my mind. I was surprised. Do I really present effectively in the class? Does my teaching appear to be that effective in classroom teaching? How much influence do teachers' viewpoints have on better classroom practices? I recalled my classes of Cambridge University GCE A level, higher secondary level and graduate classes where I rarely entered with teaching materials. More or less, being a student of mathematics education, I consider that I am aware about different teaching and learning theories. I do not think that these are just theories to learn inside the university boundary. I believe those theories can be implemented in the real field with some adjustment according to the context, time and available materials. I questioned myself. How much do I apply the methods that I prefer others to use? What are the intrinsic and extrinsic gears that dis/courage me to present inside the classroom? Is it affected due to me, students, curriculum, environment or any other reasons? Do I try to bring the quintessence of modern approaches (such as constructivist, collaborative, etc.) in my teaching, and at which level? What are the underlying assumptions behinds using certain teaching and learning approaches?

Though I completed my research project in my master study, I was not satisfied with my own product. Since then, the agenda of exploring the classroom

issues in mathematics including the nature of mathematics, classroom pedagogy, curricula, and assessment practices have been growing day after day in my mind. I wanted to go beyond identifying the patterns and to establishing the causal relationship among variables. I wanted to do something that can improve my classroom practices. The mathematics I learnt in my school level and the mathematics I view as a student of post graduate level are very much different in nature. I walked various modes as a student and as a teacher viewing the nature of mathematics and applying pedagogical practices. These incidents frequently encouraged me to conduct research on the nature of mathematical reality (Lerman, 1986; Luitel, 2013) and teachers' beliefs in the diverse nature of mathematics, and how it influences classroom teaching. At the same time, I was interested to unpack my own beliefs and practices about the nature of mathematics and mathematics teachings, as these two are entwined components. In this regard, I agree with Hersh (1986), Thompson (1992) and Beswick (2012), who advocate that a person's understanding of the nature of mathematics predicates that person's view of how teaching should take place in the classroom. Now, I discuss the construct 'belief' and beliefs of mathematics teachers in greater detail in the following section.

Beliefs System: Hidden Power to Shape Practices

Beliefs and belief systems began to be explored in the beginning of this century, particularly by social psychologists (such as Bem, 1970; Rokeach, 1968; Schoenfeld, 1992). Different psychologists and educators have used the construct "beliefs" in different ways. And sometimes, it is very difficult to separate beliefs from attitudes and values. In this regard, Bem (1970) mentioned that "Beliefs, attitudes and values do seem logically connected" (p. 4). After reading a series of literatures on beliefs, I came to understand that beliefs constitute the totality of an individual's

knowledge, including what people consider as facts, opinions, hypotheses, as well as faith.

In this section, I limit myself to the beliefs of mathematics teachers in mathematics and teaching mathematics. When the notion of context became recognized in classroom teaching, the issues of teachers' beliefs about mathematics and its teaching gained popularity in the field of mathematics education research.

Felbrich, Kaiser, and Schmotz (2014) argue that "beliefs constitute a central part of a person's professional competencies and are crucial to the perception of situations as they influence our choice of actions" (p. 209). Many educators (Thompson ;1992; Beswick, 2012) have explained belief to be very important in the professional life of any individual. It is widely discussed that we should hold a set of positive beliefs to accumulate beliefs that are more positive. If we start with negative beliefs, we would end up accumulating beliefs that are more negative. In this regard, Wilson and Cooney (2002) mentioned that "there has been a considerable amount of research on teachers' beliefs based on the assumption that what teachers believe is a significant determiner of what gets taught. How it gets taught, what gets learned in the classroom" (p. 128). As humans, we are continually engaged in a state of "confirmation bias" whereby we seek for "confirmatory evidence in support of already existing beliefs and ignore or reinterpret disconfirmatory evidence (Shermer, 2006).

Let me present some examples of beliefs that can have positive as well as negative effect on the field of mathematics pedagogy. A teacher who believes that learning mathematics is doing difficult problems may deal with difficult problems inside the classroom. However, there are some beliefs that can be very inhibiting in life. Different people develop different images through the interaction with the

people, contexts and environment. The value system is shaped based on images they develop, which is regarded as belief of an individual. There are several beliefs about the nature of mathematics and its learning theories. The belief that only some people have a “math brain” or a “math mind”, the belief that mathematics requires logic and no intuition; the belief that it is always important to know how to get the answer, the belief that learning mathematics requires a good memory; the belief that there is one best method to do a math problem; the belief that math is done by working intensely non-stop; the belief that men are better than woman; the belief that mathematicians do problems in their heads; the belief that there is a magic key to doing math; the belief that math is not creative; and the belief that use of fingers for counting isn’t math-smart are some of the common myths identified by Kogelman and Warren (1979).

I have experiences of mathematics teaching for more than a decade in various educational institutions from primary school to the university level. The beliefs I hold regarding the nature of mathematics, teaching and learning activities, mathematics curricula, assessment practices have changed radically, and the practices I employed as a teacher and as a teacher educator have been shaped by my beliefs in many ways. I believe that the examining my personal-political and professional narratives would help to improve my own practices, and may be it will be a useful document for those who are working in the field of teaching and researching in mathematics education. Now, I discuss how I investigate my research agenda through various emerging and evolving threads as inquiry.

Evolving Threads of My Inquiry

I have various useful stories to share in my community of practices on mathematics education. I have made sincere attempts to give sense of those anecdotes, generate meanings out of them, and critically assess their underlying assumptions. It

was a good experience for me as a teacher while encountering with students and other mathematics professionals who viewed mathematics, teaching and learning mathematics, curricula, assessment in different ways. When I got admitted at New Age University[1] for Master degree, I had ample opportunities to examine my experiential knowledge of teaching and learning mathematics with many traditions and practices of mathematics education all over the world. In this context, I have developed some threads in my research journey that helped me to be more focused on the issues and led me to articulate deeper and wider meanings in those agenda. Although maintaining the continuity on the thread in the research journey was a challenging task, it surrounded me all the time to investigate the useful and appropriate personal-professional narratives. The major threads in this study are: a) nature of mathematics, b) mathematics curricula, c) pedagogy, and d) assessment. Let me briefly discuss how those threads evolved into my research.

Nature of Mathematics From Absolutism to Fallibilism

One of the threads in my research is the nature of mathematics. I was grown up with the view that mathematical knowledge is unchangeable since my early school days. Once I started teaching, I spent a considerable time promoting the view that *mathematics is a body of pure knowledge* (Luitel, 2009). There was always (and still it is) an engaging debate among mathematics educators regarding the nature of mathematical knowledge. In the past, the most widely accepted view about the nature of mathematical reality was Platonism. For Plato, mathematical statements and objects are mind-independent and abstract. (Kitcher, 1984). My thoughts were with the notion of Platonism for many years. As the other side of the coin, I came to know that the non-Platonistic picture of mathematical reality also exists. It was a big

[1] This is a pseudoname used for the university where I enrolled for graduate and post graduate study.

surprise to me. I wonder (how) it exists in the globe of the nature of mathematics. At this point, I was thinking of conducting my study on the nature of mathematics that was expressed by the mathematics teachers. On the other side, I was also thinking of identifying the possible reasons for why mathematics teachers are guided by such nature of mathematics. As days passed by, I came up with some other ideas on this theme. In place of identifying the nature of mathematics as expressed by many teachers, I landed on exploring my changing beliefs about the mathematical reality.

Mathematics educators started to search the utility of mathematical knowledge in different cases with the existence of mathematical reality in context. Lerman (1990) made a very inspiring argument on the alternative views of the nature of mathematics. The interaction with his texts was a point of departure in my professional context. He used Lakatosian notion of quasi-empiricism as a theoretical basis to discuss the nature of fallibalistic view in mathematics. I am impressed with the view of Ernest (1991) on the fallible view of mathematical knowledge. According to him, mathematical knowledge are corrigible and always open to revision. Such argument challenged my deep-seated beliefs in the absolutist nature of mathematics.

The sincere attempt of D'Ambrosio on ethnomathematics has developed sufficient spaces for developing culturally contextualized mathematics education, and became an eye-opener for many practitioners, like me, who have been suffering from the uni-dimensional view of the nature of mathematics. At this point, I was overwhelmed with the ideas of the nature of culturally contextualized mathematics. I came up with a research question, what is the nature of mathematics in our multicultural Nepali environment? I was also interested in exploring the nature of mathematics (absolutist or fallible) of my own community. As I interacted with lots of literatures, I thought I need to move forward.

The discourse created by Luitel (2013) on “mathematics as an im/pure knowledge system” deconstructed 'either-or' structure of the absolutist and fallible nature of mathematics and helped shaping my beliefs towards an integral perspectives. From my experiences too, I came to realize that the overemphasis on “pure” nature of mathematics has disempowered students and teachers, and created a pathetic situation in our (Nepalese) mathematics education. In such case, the exclusive use of either pure or impure perspective may hazard the vision of inclusive and empowering mathematics for promoting ‘glocalised’ sensibilities among Nepali learners. In this context, I am thinking about the space for promoting the local forms of mathematics (impure) and formalised mathematical knowledge (pure) in the field of nature of mathematics. The long and meaningful journey I made with the nature of mathematics has created sufficient space in my research agenda. At this moment, I prepare a research question for my inquiry: *in what ways have my beliefs towards the nature of mathematics been developing from absolutist to fallible, and what sorts of belief system is likely to promote inclusive nature of mathematics?* Here, I am depicting a range of beliefs in the nature of mathematics and how they relate in my pedagogical practices. With the help of some useful narratives and relevant literatures, I critically reflect on the dominant nature of mathematics that has governed the Nepali mathematics education.

De/contextualized Mathematics Curricula

Another thread in my study is mathematics curriculum. I was grown up with the modernist views of curriculum although I came to know much about curriculum only after I spent a few years in my professional life. I thought perennialism and essentialism should be the guiding philosophy in developing mathematics curricula. The perennialists believe that humans are rational and the aim of education is to teach

such perennial theories and principles that help pupils to make wise forever. (Hutchins, 1953). For this, the great books written by history's finest thinkers and writers (such as Euclid's *Elements on geometry*, Newton's *Optics*, and Freud's *The Sexual Enlightenment of Children*) should be taught in the schools to develop moral and intellectual capacity. The deep seated beliefs of perennial thinking directed Nepali mathematics curricula towards *mathematics as a collection of pure subject matter*. At this point, I was thinking of how mathematics curriculum in Nepali schools has been developing. How has the notion of perennial and essential influenced on developing the curriculum? As the days passed by, I came to realize that there are various philosophical standpoints and studying the influences of particular philosophical standpoints might not serve the need of my professional development.

On the other hand, essentialism was grounded in a conventional philosophy that argues that schools should not aim for drastically reshaping the society. It aims for transmitting traditional moral values, intellectual knowledge and skills to make students model citizens (Bagley, 1938). In my knowledge, the view that essentialist educators hold has dominated the process of preparing Nepali mathematics curricula. It promoted the notion of *curriculum as cultural reproduction* (Schubert, 1986). When I was a student at the undergraduate level, I was taught various ways of curriculum development (as suggested by Tyler, 1949; Taba, 1962; Saylor & Alexander, 1974). The steps prescribed by those educators promote a view that the experts need to declare what is to be taught to the students, thereby not paying much attention to teachers' and students' interest and contextual issues.

In the course of time, I got opportunity to interact with postmodern perspectives of curriculum and its development, which welcomes the dimension of meaning, context and learners' personal experiences in the process of curriculum

development and implementation. In the discourse of culturally contextualized mathematics curriculum, Luitel (2009) argues "postmodern curriculum perspectives promote local and contextual narratives, thereby advocating creative subjectivities as an epistemic basis" (p. 21). The metaphors presented by Schubert (1986) – *curriculum as an agenda for social reconstruction, curriculum as experience, curriculum as currere*, have become a gateway to creative and transformative thinking in the field of mathematics curriculum. The encounter with the metaphors presented by Schubert in relation to various dimensions of curriculum was a point of departure in my journey of viewing curriculum. At that point, I was interested in investigating which curriculum metaphors, explicitly and explicitly, have guided the development and implementation of the curriculum. What could be the possible metaphors that describe the present curriculum practices?

Moving ahead with the various curriculum metaphors, I interacted with the notion of mathematics curricula for inclusion, equity and social justice. Perhaps, the various forms of curriculum development exist as mentioned by Schoenfeld (2014), "different national premises about the nature of thinking and learning lead to different premises about the most effective forms of instruction, which lead to different forms of curricula" (p. 50). The journey I made with the notion of curricula as a collection of subject matter to the vision for inclusive and democratic society informed me to construct yet another research question for my inquiry: *How have I been developing my beliefs towards mathematics curriculum, and how can I develop an inclusive and transformative vision for a mathematics curriculum in the Nepali context?*

Banking Pedagogy to Critical Pedagogy

My journey as a mathematics teacher began with a "good algorithmic problem solver". The majority of mathematical problems demanded repetition and

memorization of skills. In fact, I was mimicking the routine problems in artificial situations to get the correct answers. I needed to wait a long to make sense of real life problems and mechanical problems. The overemphasis on decontextualized mathematical problems developed me as a machine to re/produce answers. At this point, I was searching the straight forward responses on what the best ways of teaching school mathematics were. How can a teacher make students achieve high grades in written tests?

My shift from problem solver to identifying lots of tricks, tips and techniques in mathematics pedagogy have still promoted transmissionist notion of pedagogy in which spoon-feeding method of teaching is at the center. As a student and teacher of mathematics, I have many stories in which monological pedagogies are in practice where students are viewed as passive listeners who never raise questions and put their thoughts in the classroom. My notion of decontextualized pedagogy encourages teaching mathematics as an exclusive body of knowledge without relating them to the local context. Therefore, my deep seated desire to move beyond the transmissionist pedagogy was restrained by the narrowly conceived notion of the nature of mathematics and mathematics curricula. When I started examining and reflecting my own thoughts on viewing the nature of mathematics and curricula, I was able to question my own deep rooted teaching and learning approaches. At this point, I came up with another set of questions. I was interested in investigating how students learn particular subject matter inside the classroom. How do teachers use particular teaching strategies in mathematics classes?

Later on, the humanistic approaches of teaching mathematics (Ernest, 2012) and the self-reflection as a tool to improve classroom teaching (Malatji & Wadesango, 2014) created lots of spaces to move ahead from the decontextualized mathematics

pedagogy to contextualized and inclusive pedagogy. The moment I realized that *teaching as a political act* was a point of departure in my pedagogical practices. The seminal works *Critical Pedagogy* (Giroux, 1983), *Pedagogy of the Oppressed* (Freire, 1993), *Teaching for Social Justice* (Gutstein; 2006) began to reshape my beliefs towards critical pedagogy in mathematics. In this context, I felt the urgency to investigate the series of beliefs and practices in mathematics pedagogy I went through, which may produce a new sort of insight that can be more useful pedagogical innovation in our context. I thought my autobiographical impulses as a student, mathematics teacher and teacher educator viewing pedagogy from the transmissionist act to political act may provide enough grounds to examine the present scenario of mathematics teaching and envisage for the contextualized and inclusive pedagogical practices. In this scenario, I came up with another research question in this inquiry: *how have I been developing my beliefs towards the pedagogical practices, dominant in the field of mathematics education in Nepal, and how can my "critical pedagogy" be helpful as a good alternate pedagogy for Nepali society?*

Measuring Students' Achievement to Assessing Students' Performance

In many cases, the conventional assessment system demands students to reproduce the subject matter they learn. The tendency of receiving the good score as the ultimate goal of school education has overemphasized written tests in all grades. In the name of standaralized evaluation system, evaluation has been viewed as a separate part of teaching and learning activities though many educators argue that students' evaluation should be a natural part of the developmental process within classrooms (Patton, 2011). It is further argued that children's learning is most influenced by ongoing and continuous assessment practices. During the course of time, Nepal government developed a policy for formative and continuous assessment

system. I, as a teacher, have been struggling a lot to see the existences of continuous assessment system where the disempowering notion of curricula and conventional approaches of teaching and learning have occupied the hearts and minds of teachers and school leaders. When I learnt formative and continuous assessment system in my university, I tried to apply them in my schools. But, I could not be able to convince my school principal. In this context, I was interested in investigating the possible ways of using assessment strategies in Nepali context.

Ernest (2015) grouped the aims of school mathematics in three categories: standard, unintended and visionary. It seems to me that Nepali mathematics curriculum are largely serving for standard aim, which demands functional numeracy, work related knowledge, and advanced and specialist knowledge. It is felt that the unintended aims (i.e. negative beliefs towards mathematics, etc.) have been rooted deeply, and the visionary aims (i.e. social empowerment and equity, etc.) are left behind. The assessment practices are also designed to serve the standard aims of school mathematics, which is essential but not sufficient. The long-rooted beliefs and practices on unhelpful notion of assessment (such as measuring students' achievement) in school education is one of the major constrains to move beyond the existing assessment practices. The ideas of unintended and visionary aim of school mathematics helped to come up with another set of questions in my research journey. What could be the possible ways of assessment to serve the visionary aim of school mathematics? How does the present assessment practices help (or/and does not help) the unintended and visionary aim of school mathematics?

In my experience as a teacher, teacher educator and textbook writer, while developing principles for designing mathematics curricula in Nepal, Tyler's model of curriculum development has been used in/directly. Tyler prescribes certain steps as

the *god-made-fact* for designing the curriculum in which defining the measurable objectives is one of the steps. The assessment strategies are designed to measure those already prepared objectives in a linear fashion. I came to realize that such a reductionist notion of assessment is not helpful to cultivate the performance (rather than achievement) and the experiences of the students. In my professional life, there are many engaging narratives related to assessment practices that explicitly capture the current assessment practices with underlying assumptions. I believe that unfolding those epiphanies helps me to improve my practices and may create space for others to reexamine their thoughts and practices in this very important construct. At this moment, I came up with another research question for my study: *how have I been developing my beliefs and practices in students' assessment, and how do I envisage the better assessment practices that promote assessment as an inseparable and continuous part of teaching and learning?*

Em/pathetic Situation of Nepali School Mathematics

Elsewhere, in my above argument, I discussed that school mathematics in Nepal carries a disempowering image of mathematics as a purely abstract knowledge system that is largely disconnected from our context and practices. In this section, I engage myself with the condition of Nepali school mathematics. Mathematics is taught as a compulsory subject in Nepal up to tenth grade. In addition, there is also a provision of additional mathematics in grade nine and ten. The students who are interested in continuing their higher study in science, engineering or/and mathematics, they go for additional mathematics. This is perhaps a significant moment for many students to show their "smartness" in mathematics, choosing additional mathematics. The situation of school mathematics is not satisfactory in many ways.

Although there are my reservations in current assessment practices, the National Assessment of Student Achievement (NASA), conducted by Ministry of Education, Education Review office, showed very poor status of school mathematics in Nepal. According to NASA (2011), the national average of grade eight is 43 out of 100 with standard deviation 21.3. The worst part is that the national average in 2011 was 4% weaker than that in 2008. The result showed that the students are good at recognizing the correct answers, problems related to fundamental operations, basic manipulation of data and numbers, and at calculations with few steps, but they are weaker in problem solving and reasoning skills. NASA (2011) also suggested that,

> It seems that too often the heavy loaded curriculum, the ambitious learning materials as well as the large class sizes lead to a situation where the students are listening to the teacher instead of doing creative or inquiry-related works which might promote the ability in higher cognitive skills. (p. 14)

Again, in the year of 2013, the research conducted by Ministry of Education, Education Review office found that the average achievement in mathematics of grade eight students is 57% in the private schools whereas it is 26% in the community schools.

In the result of SLC, mathematics has been noted as one of the subjects in which a high number of students are labeled 'failure'. As an educator and a researcher, I am aware of the context, purpose and the limitations of national assessment. I am not arguing from the perspective that the achievement scores should be enriched without making changes in other dimensions. Of course, we all expect good performances of schools and students, but not in a conventional way.

Schuck and Pereira (2011) discussed two aspects of teaching mathematics in their seminal book *What Counts in Mathematics Teaching*. The first aspect is that the

beliefs, attitudes and emotions of both teachers and students are very important drivers for successful mathematical experiences. The second aspect is about the affective and cognitive sides of learning and teaching mathematics, which are inseparable. They suggested creating positive and encouraging environments to improve the attitudes of students towards mathematics, and disrupt their negative beliefs towards mathematics and learning. During the preparation of teacher education courses in Nepal, Luitel and Taylor (2010) mentioned that,

> The first step in addressing the problem is to reveal the deeply hegemonic grip of this restrictive form of mathematics education on the hearts and minds of those who control the institutions of higher education, the sector that is instrumental in reproducing the extant culture of "world standard" mathematics, mathematics education and mathematics teacher education. (p. 386).

I believe that it is not easy to reframe our practices. For this, it requires uncovering of our assumptions and challenging of our beliefs. Keeping these all contexts in mind, I thought it is urgent to assess my/our values and assumptions about the nature of mathematics, curriculum, learning approaches, and assessment.

Purpose of the Study

The overarching purpose of this study was to improve my practices as a teacher educator. For this, I believe that unraveling own beliefs and practices is a major and essential task to move ahead. The purpose of this study was therefore to explore and critically re/examine my beliefs towards the nature of mathematics, mathematics curricula, pedagogical practices and assessment strategies. In doing so, I attempted to unfold and critically assess my deep-seated beliefs, stories of practices,

struggles (within me and outside), changes occurred in my beliefs and practices, and endeavors to envisage the better perspectives in teaching and learning.

Research Questions

To develop this section was really challenging for me. I had thousands of questions in my mind. On the other side, there was no any specific question. I knew that the journey I decided to take could not find "answers" to any questions. Nor was my purpose to come up with lots of solutions that work as panacea in the field of mathematics teaching and learning. As I indicated in the purpose section, I intended to improve my own practices through this research. I wrote, rephrased, revisited and restructured my research questions throughout my study. Finally, I came up with the following research questions.

1) In what ways have my beliefs towards the nature of mathematics been developing from absolutist to fallible, and what sorts of belief system is likely to promote inclusive nature of mathematics?
2) How have I been developing my beliefs towards mathematics curriculum, and how do I develop an inclusive and transformative vision for a mathematics curriculum in the Nepali context?
3) How have I been developing my beliefs towards the pedagogical practices, dominant in the field of mathematics education in Nepal, and how can my "critical pedagogy" be helpful as a good alternate pedagogy for Nepali society?
4) How have I been developing my beliefs and practices towards students' assessment, and how do I envisage the better assessment practices that promote assessment as an inseparable and continuous part of teaching and learning?

Usefulness of the Study

According to Lerman (1990) and Beswick (2012), teachers' beliefs are precursors to change and that the teacher is the crucial change agent in paving the way to reform. Keeping this notion in mind, I then allowed myself to reflect and examine my own beliefs about mathematics teaching and learning practices which could be useful for the following reasons:

Useful for Myself

First, re-examining my beliefs and practices could be a foreground in the crucial change and improvement of my praxis as a classroom teacher, teacher educator and researcher. Examining my own beliefs by capturing the meaningful epiphanies may provide enough opportunities to reconstitute myself being aware of false consciousness and *taken-for-granted* assumptions in teacher education.

Useful for My Contemporaries

There are widespread claims about the influences of teachers' beliefs of mathematics on mathematics teaching (Thompson, 1992; Beswick, 2012).But, I found limited inquiry that has been conducted in our context. I believe that this document, capturing rich personal-professional narratives on mathematics teachers' beliefs and practices, may evoke various issues and make readers thoughtful on their beliefs and practices on teaching and learning issues.

My Theoretical Referents

What are theories? Why do we need theories in research? Does a theory orient us in our research process or provide a complete framework to be followed? It created very tacit difficulties for me while selecting theories and using them in my research. Perhaps, my research supervisor invested longer period to convince me to use theories as referents in such research, not as a cage to put all research process inside.

Perhaps, the long-seated beliefs towards certain theories resided in my mind, and I needed much effort to become aware about my beloved and potentially invisible theories (such as learning takes place through S-R bonding, mind is separate from the body, curriculum is designed and given by the experts, etc). I realized that theories are important as a student, teacher and teacher educator to view the world (in my case, the nature of mathematics, pedagogical practices, curriculum and evaluation strategies, etc.) through various lenses. But at the same time, the experiences gained through practices in the professional context should not be underestimated. In the conventional research, theories are treated as the complete framework for research. Therefore, theories in the conventional studies have great roles from the beginning to the end, i.e. from identifying research purpose to drawing conclusion.

In my study, I have used a few theories to draw certain features and to analyze certain narratives, akin to what Tobin and Tippins (1993) advocated as employing theories as referents (as cited in Luitel, 2009). While treating theories as referents, I basically used conceptual and critical reflexivity. The conceptual dimension of theories enabled me to identify their principles and underlying assumptions, which helped me to view various teaching and learning approaches in mathematics classroom, but it was insufficient at the time of analysing its contextual usefulness and their limitations. The notion of critical reflectivity helped me to deconstruct the hegemony of grand narratives, and to make sense of researcher's own experiences cultivating the possibilities culminating small t theories as discussed by Luitel (2009) elsewhere. At some point of my inquiry, I took theories as very basic entities to describe social phenomenon and attempted to describe them from my own lenses. Perhaps, my thoughts were in line with Campbell (2006) who mentioned that theories are like toothbrushes……everyone has one- and nobody wants to use anyone else's.

In this study, I used some theories as referents. There is no any “theoretical framework” I set while conducting this study. The conventional view of theory is not helpful for me that provide a general explanatory framework with descriptions and explanations for empirically observed regularities and the behavior of individual cases. As a practitioner, I think theories are to be used to improve practices and its healthy use in the field of teacher education can be more fruitful. In this study, I chose three theories as referents. Those theories are Living Theory Methodology (Whitehead, 1989, Whitehead & Huxtable, 2015), Transformative Learning Theory (Mezirow, 1991) and Knowledge Constitutive Interest (Habermas, 1972).

Living Theory Methodology

Jack Whitehead has been arguing about the necessity of self-reflection to improve one’s practices since 1982. He discussed that the significance of 'I' always exists as a living contradiction. In this context, the epistemological issues related to values, “validity” and “generalisability” should be discussed from the living perspective. Whitehead (2008) explained, “A living 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). Many conventional theories prescribe various approaches in teaching and learning as “verified truth” in the name of generalisability. In the business of education, the values, thoughts and contexts are very important aspects to make certain things happen. The teachers have key roles to improve themselves and the entire academic culture. In this regard, Whitehead and Huxtable (2015) argued that teachers as experts, and they can develop their expertise by researching their praxis to improve it and thereby generating educational knowledge.

The main purpose of my study was to improve my practice by critically assessing my own beliefs about the nature of mathematics, pedagogical practices, curricula and assessment. In this context, I found Living Theory Methodology as one of the best methodological referents which aims for improving practice and generating knowledge from questions of the kind 'How do I improve what I am doing? When Ferguson (2015) used Living Education Theory in his/her inquiry, it is mentioned that "in this approach, researchers are challenged to investigate their own values and beliefs, to openly articulate them and to describe how they can be measured and, finally, to demonstrate how they might be held to account for these values and beliefs" (p. 55). I have not used grand literatures as my guiding metaphor. I believe in the openness and transparency of reviewing as a more educative and iterative process than the more traditional "blind reviewing". For this, Living Education Theory provided me enough spaces to bring my own literature. One of the purposes of my study was to raise my narratives "politically". For this, as mentioned by McNiff (2013), living theory methodology is itself a political inquiry, making decisions about which stories are permissible and who is permitted to tell them. Due to these reasons, I chose Living Education Theory as one of my theoretical referents.

Transformative Learning Theory

Transformative Learning Theory is another theoretical referent I employed in my study. It was rooted in the work of Jack Mezirow in the area of adult education in 1991. Mezirow drew the ideas of well-known philosophers such as John Dewey and Jurgen Habermas. It explains how we make sense of our experiences with the world from the subjective perspectives. The notion of transformative learning theory is embedded in communicative learning rather than instrumental. Regarding the communicative learning, Mezirow (1997) states that it becomes essential for learners

"to become critically reflective of the assumptions underlying intentions, values, beliefs, and feelings" (p. 6). As a teacher and teacher educator, I always expect better perspectives on teaching and educating. In this context, the four processes of learning, discussed by Mezirow (1997), are very appealing to me. The first way, elaborating an existing point of view, allowed me to reflect on my own assumptions and values in mathematics education. The second way, establishing new point of view, created spaces to critically reflect on my assumptions for better alternatives. The third way, learning to transform our point of view, motivated me to amend my beliefs and practices on teaching and learning. The fourth way, transforming our ethnocentric habit of mind by becoming aware and critically reflective of our generalized bias, helped me to welcome new insights and thoughts for reshaping my actions from the heart, not only from the mind. In the similar manner, I used five distinct but interconnected ways of learning as mentioned by Taylor (2015) – cultural-self knowing, relational knowing, critical knowing, visionary and ethical knowing, knowing in action.

Many researchers (Afonso, 2006; Cupane, 2007; Luitel, 2009) in the areas of teacher education have used transformative learning theory as a guiding principle in their research studies, advocating research as a means for transformative learning. In this regard, Taylor (2013) mentioned that, "researchers as transformative learners draw on constructivist, critical social and arts-based epistemologies to examine reflectively, critically and imaginatively their lived experiences revealing the historical and socio-cultural framing of their personal lives and professional practices" (p. 2). Looking into these ideas, I realized that transformative learning theory is very applicable in my context. As a citizen of non-Western societies and the nation where neocolonial thinking is gaining popularity day by day, the transformative learning has

created spaces to assess my false consciousness on the so called dominant theories of education and learning.

When I committed myself towards structural shift in my thoughts, feelings and actions towards mathematics teaching and learning, I found myself to have been inspired by the notion of transformative learning theory. I also realized that critical refection is a gateway for transformative learning and professional development. Relating to critical reflection, Liu (2013) argued that combining critical reflection in education research helps to link the abstract theory of reflective teaching with the individual classroom and research contexts. The essence of transformative learning is, therefore, one of the useful theoretical referents in my study as I am interested in making sense of my various professional episodes reflecting critically on the presuppositions underpinning my/our values and beliefs.

Knowledge Constitutive Interests

Another theoretical referent I employed in my research is Habermasian knowledge constitutive interest (1972). This idea discusses the fundamental human interest that influences how knowledge is constructed. For Habermas, the basic human interest is grounded in rationality. The three knowledge-constitutive interests (i.e. technical, practical and emancipatory), as argued by Habermas, are rooted in the human existence and expressed in a particular type of inquiry.

The technical interest is a view that knowledge exists somehow apart from people “out there” and it can be discovered. It aims for the prediction of the social phenomena based on normative-analytic science assuming that control of the natural environment is necessary in hypothetico-deductive model of logic. At this moment, I realized that many of our actions as mathematics teachers and teacher educator have been guided by technical interest, thereby focusing on knowledge transmission

approaches in mathematics teaching as ultimate facts. In this study, I have used the notion of technical interest partially in assessing how my thoughts and practices were in/directly guided by the notion of technical interest.

Another view is that knowledge is recognized as being something that exists inside/among people “in here” and people can construct them together. Habermas (1972, as cited in Grundy, 1987) mentioned that, “the basic orientation of the technical interest is towards control, but that of the practical interest is towards understanding” (p. 12). The meaning making in the context with the interaction among the learners is the major access point in developing knowledge. Regarding the curriculum development process, Grundy (1987) mentioned that

> A curriculum informed by practical interest is not a means-end curriculum by which an educational outcome is produced through the action of teacher upon a group of objectified pupils. Rather, curriculum design is regarded as a process through which pupil and teacher interact in order to make meaning of the world." (pp. 14-15).

The curriculum envisaged by practical interest is closer to the metaphor discussed by Schubert (1986), curriculum as experience, in which educational means and ends are taken as inseparable parts of a single process – experience, as advocated by influential philosopher John Dewey. In this context, the practical interest helped me articulate the modes of various inter/personal understanding on mathematics and teaching mathematics that are generating meanings and perspectives in various dimensions of mathematics education in my/our personal and professional life.

The two major pillars of emancipatory interest are autonomy and responsibility. For Habermas, emancipation means independence from all that is outside the individual. For this, the critical-self reflections are the pathway towards

liberation from dogmatic dependence. At the same time, the self-directed responsibility with awareness of dominant forces that is embedded in one's worldview is necessary to move ahead towards emancipation. The emancipatory interest thus gives rise to critical perspectives promoting the counter-hegemonic vision of teaching and learning. Critical consciousness embedded curriculum helps to unpack the cultural nature of education and *taken-for-granted* assumptions about teaching, learning and assessment (e.g. bell-shaped normal curve). For this, critical pedagogical practice helps students and teachers to share authority and control in relation to generating knowledge.

In this context, I used emancipatory interest to develop awareness with the false consciousness, which is a new form of hegemony, on the various episodes of my life as a student, a teacher and teacher educator. From the perspectives of knowledge constitutive interest, I tried to become aware of various disempowering forces that were constraining me for a longer time, and attempted to envisage better alternatives in teaching and learning in an imaginative form.

Chapter Summary

In this chapter, I have discussed how my research agenda emerged from my professional context representing different aspects of the main research problem on beliefs and practices about the nature of mathematics and teaching mathematics. I, then, raised some issues with a number of deep-seated questions, under various threads of my research agenda. The major threads I discussed in this chapter were: nature of mathematics from absolutism to fallibilism, de/contextualized mathematics curricula, banking pedagogy to critical pedagogy, measuring students' achievement to assessing students' performance. Reflecting upon my experience as a student, teacher and teacher educator, I formulated four research questions aiming at assessing my

own beliefs and practices about the issues raised in the section of my evolving threads to envisage better perspectives on teaching and learning mathematics. My professional engagement in various institutions as a teacher and teacher educator provided me with rich experiences to come up with various issues in the field of mathematics education.

I also established the usefulness of the study to me as a researcher and for the community of mathematics education by relating them to their professional practices. I, then, discussed the major theoretical referents I employed in my study. While doing so, I attempted to explain how those theoretical perspectives could be useful in my study.

CHAPTER II

CRAFTING MY PATH(S) OF RESEARCH

In this chapter, I have explained the possible ways that I have used in my research journey. At first, I have depicted my dilemmas and intentions in this research study. I have, then, discussed my philosophical beliefs and research paradigm that guided my intentions and research issues. This was important for me, as a researcher, to be clear about the research method I was going to use considering the space for ambiguity, what was research for me, who my research participants would be, what did "data" mean to me, how would I generate the narratives, what quality standards and ethical issues I would employ in my research.

The Dilemma

After more than a decade of teaching mathematics, I came to realize that my journey as a teacher has been filled with accomplishments and disappointments. Many facets of teaching have caused me to ponder on my efficacy as a teacher, teacher educator and a novice researcher. I have often asked, "What are the best ways of teaching mathematics?", and, "How can I become successful as a teacher?" I could not get an adequate answer to these questions. I have discussed my professional journey illustrating some narratives as threads of my inquiry in the first chapter. However, the questions I posed in the threads of my inquiry as a series of thoughts about my journey as a mathematics student, mathematics teacher and teacher educator kept me thoughtful all the time. I knew after ten years of teaching that I was not the same as when I started my career in teaching. Many changes have occurred and those changes have taken place because of my desire for self-development as a teacher.

I realized that my changing beliefs towards the nature of mathematics, mathematics teaching, curriculum and assessment strategies have taken a long journey. I do believe that this is a never-ending journey. My curiosity was peaked while doing the course work in mathematics education in New Age University. I wondered what my identity as mathematics teacher was. How did I facilitate learning? How could I improve what I was doing: the facilitation? These open ending queries motivated me to conduct this study.

Quantitative and Qualitative Research

I got an opportunity to learn a course "Research Methodology in Education" in my Master's degree. During this course, I felt ashamed about the research project I conducted in my Bachelor study. I came to know two traditions of research methods – quantitative vs. qualitative. Bryman (2012) described quantitative research as "entailing the collection of numerical data, as exhibiting a view of the relationship between theory and research as deductive and a predilection for a natural science approach (and of positivism in particular), and as having an objectivist conception of social reality" (p. 160). As a student of mathematics (education), my interest was to identify such findings that maintain objectivity, replicability and causality. The preparation of short questionnaire, going for pilot study, assuring the tools' validity and reliability, administrating the questionnaire, making input of variable and data sheet onto the SPSS software, drawing tables and statistical measures from the data, testing the hypothesis, and landing with the finding(s)were very definite and priori design to follow. The achievement in mathematics, the factors affecting mathematics achievement, cause and effect relationship among the uses of various teaching and learning approaches with mathematics achievement were the major research concerns

in the initial stage of my study in *Research Methods in Education* course. Creswell (2012) mentioned that;

> …in quantitative research, the investigator identifies a research problem based on trends in the field or on the need to explain why something occurs. Describing a trend means that the research problem can be answered best by a study in which the researcher seeks to establish the overall tendency of responses from individuals and to note how this tendency varies among people. (p. 13)

As a requirement of the course in the Master's level, we conducted a research project on *career aspiration of higher secondary level students* with the help of pre-set questionnaire. When we came up with the findings at the end of the study, I had doubts in many places. One of the major doubts was on our attempt to measure students' career aspiration objectively. At the time of informal discussion with the research participants, they shared their narratives on their career aspirations. But the questionnaire we prepared could not capture such rich narratives. On the other hand, capturing individual narratives may not be the purpose of the study under quantitative design. But, this incident made me rethink on the usefulness of conducting survey research in the field of education in general in mathematics education in particular. There were (are) many issues in mathematics education. Centrally developed curricula, culturally decontextualized nature of mathematics, exclusively teacher-centered pedagogy, unidimensional approaches of evaluation, were deeply discussed inside the classes of Mathematics Education, Teaching and Learning Issues, and Curriculum and Evaluation in Mathematics Education.

During the time of self-dissatisfaction on the entire quantitative notion of the research, my facilitator, in the same course *Research Methods in Education*,

introduced another tradition in research *Qualitative Approaches in Research*. I came to realize that qualitative research is deemed to be much more fluid and flexible than quantitative research. It emphasizes discovering novel or unanticipated findings and the possibility of altering research plans in response to such serendipitous occurrences. In this regard, Bryman (2012) mentioned that;

> The stress is on the understanding of the social world through an examination of the interpretation of that world by its participants; and an ontological position described as constructionist, which implies that social properties are outcomes of the interactions between individuals, rather than phenomena 'out there' and separate from those involved in its construction. (p. 380)

I spent a considerable amount of time to make sense of these two research traditions (quantitative and qualitative) and differences of these well-known classifications in the research traditions. I realized the fundamental differences on the nature of knowledge and the ways of perceiving them. In quantitative research, it is assumed that knowledge is "out there" to be discovered; there is a physical, knowable reality that can be observed by a trained researcher. A qualitative perspective assumes that knowledge is constructed through communication and interaction; as such, knowledge is not "out there" but within the perceptions and interpretations of the individual(s).

After reading several papers of Luitel (2009, 2010, 2012, and 2013) with engaging narratives of mathematics classroom, teaching and learning approaches, the nature of mathematics in Nepali context, I was deliberately shifting onto the bank of qualitative research. Perhaps, my priority of research purpose might have changed from establishing the causal relationship among variables to deep understanding of social phenomenon in relation to mathematics education. At that time, I was also

teaching in some private schools as a mathematics teacher. I was worried about the good grades of my students. How my students can get good grades in mathematics was my major concern. By the time, I read some papers and books on qualitative research. I was interested in the same. I met my teachers and shared my research interest in investigating possible reasons for the low achievement in mathematics. I could not convince him of my agenda, and finally agreed on the sequential mixed methods design. I did not know much about mixed methods at that time. I thought it was the combination of both qualitative and quantitative in a single study. The study attempted to find out the achievement level of the students in mathematics, find the significant differences in math achievement and the personal factors of the students; and finally investigate the possible causes qualitatively behind the quantitative results. As a practitioner, it was a good opportunity for me to use both methods in a single study. I followed my supervisor and completed my Master's research project.

Though I completed my Master's research project, I was not satisfied with my own product. The seed of qualitative research and the research agenda on exploring the classroom issues in mathematics including nature of mathematics, curricula, and assessment practices have been growing day by day in my mind. Perhaps, I was not interested in identifying the patterns and establishing causal relationship among variables believing that those actions could not improve my classroom practices. *Mathematics is discovered or invented* (Ernest, 1999) was one of the well-discussed construct in our Master's classes, and it encouraged me a lot to study the various natures of mathematics. I was interested in discussing the various natures of mathematics (Lerman, 1990; Luitel, 2013) and teachers' beliefs towards those natures of mathematics, and how they influence classroom teaching. But I could not.

Though qualitative and quantitative methods have been used largely as methods, and many people even use as paradigms, for me, this classification is very simplistic. Due to the complexity of knowledge, such classification cannot cover the philosophical dimensions (such as: epistemology, ontology and axiology) of the research work in detail. Willis (2007) mentioned that the terms qualitative and quantitative often imply that the main differences the type of data collected: numbers or something else such as interviews or observations. He further suggested using the terms paradigms that better capture the nature of the world and how humans can better understand the world they live in to assumptions about the proper relationships between social science research and professional practice.

What Was I Looking for?

I was a student of mathematics education from the beginning of my higher study. At this stage, I have gathered rich experiences of teaching mathematics from the school level to the university level. I began my teaching career believing that truth can be quantified and such truth can be generalized for a broader population. This notion guided me towards the process-product moment of mathematics education research (Stinson & Bullock, 2015) in which researchers rely primarily on quantitative statistical inference as a means "to 'predict' social phenomena by 'objectively' observing and measuring a 'reasonable' universe. This way of thinking and doing research in social science, termed 'positivism' by Willis (2007), was/is about controlling the environment and, explaining the general social pattern of behavior. After a long journey as a mathematics teacher, I started questioning the generalized nature of social behavior assuming that controlling the environment is not possible and the human nature is ever-changing.

As a practitioner, I have been continuing to de/construct my views about the nature of truth, possible ways of acquiring them and their worth in my professional context. Therefore, as a researcher, I needed to be somewhat clear on the nature of knowledge that I was interested to generate, the ways of inquiry that I was to apply while generating knowledge. At the same time, I was searching the spaces where I could discuss those epiphanies of my personal-professional career that I valued as important to critically asses during the study.

In my journey of understanding educational research, I came to know that ontological and epistemological assumptions were the main role players to select appropriate research methodology. Hitchock and Hughes (1995) suggested that ontological assumptions give rise to epistemological assumptions; these, in turn, give rise to methodological considerations; and these in turn, give rise to issues of instrumentations and data collection (as cited in Cohen Manion & Morrison, 2007). On the other hand, my inquiry was all about the gradual changes of my own ontological and epistemological assumptions of viewing mathematics, teaching mathematics, mathematics curriculum and assessment practices in mathematics. Therefore, for me, research in mathematics education should help to transform me as a teacher/educator. Such research in mathematics education embraces the agenda of 'research for all' to develop mathematics education as an inclusive learning enterprise (Luitel et al., 2012). Now, I discuss three philosophical assumptions (ontological, epistemological, and methodological) that guided my research journey.

My Ontological Assumptions

The aim of my research was to explore and critically assess my own beliefs and practices about the nature of mathematics, curriculum, teaching and learning, and assessment. I assessed the beliefs of contemporary teachers with my series of beliefs

critically. Denzin and Lincoln (2005) disclosed that a set of ideas or framework is ontology (p.21). For me, reality depends upon the time and context. As Luitel (2009) revealed, “Aspects of my ontology are relativistic without which contextual meaning making turns out to be a difficult endeavor” (p. 31). However, it is difficult to create contextual meaning on the nature or essence of the phenomena being studied. So, while studying such phenomena, the ontology of natural science (singular reality) did not help me. For me, the reality is multiple and contextual. However, as a teacher and a teacher educator of mathematics, I cannot deny the usefulness of objective knowledge. But in my case where I was planning to critically asses my own n-narratives, I needed to stand for subjectivity.

My perception towards teaching before a week and after a week should not necessarily remain the same. As a teacher, once I come to encounter a challenging situation and solve it, I do not generalize it as a conclusion. Rather, I take it as a lesson and see the other better alternatives to enhance my professional activities. So, I can be a good practitioner through the subjective reality and transforming my own beliefs and practices according to the time and context.

My Epistemological Consideration

To me, as a researcher, knowledge is subjective, as historical conventions (Ernest, 2006), and context oriented. I believe that the knowing process is fallible. In my perception, people create their own understanding about each phenomenon as the result of their prior experiences in the existing socio-cultural context. I do not celebrate the extreme view of epistemology of objectivism. Earlier, I had the absolutist view towards mathematics, later I was influenced by the fallibility nature of mathematics. Now, I advocate the constructivist nature of mathematical knowledge and think beyond. So, I recognize that my perceptions of epistemology are subjective

and continuously evolving as I try to de/construct my beliefs through my lived experiences.

Regarding the epistemology of mathematics education research, Pais and Valero (2012) explained that, "the notion of learning as being, a dialectical process where learning is both objectification (knowing) andsubjectification (being or becoming), is a way of dealing with the traditional dichotomy of the individual and the object of knowledge" (p. 16). While working with the subjectivist approach, I believe in "multiple ways of knowing" (Guba & Lincoln, 2005). I acknowledge that disclosing my lived experiences may re/present multiple realities that exist in the context of my beliefs and pedagogical practices. Luitel (2009) also argued that an exclusive postmodern epistemology of *knowing as ironic gazing* is likely to over-celebrate the ironic aspect of language, thereby reducing knowledge to an exclusively subjective, fluid and fragmented form.

Multi-Paradigmatic Research Study

For any researcher, research plan serves as a roadmap or a blueprint that tells the investigator how to move along in the overall research journey. As I already mentioned my epistemology and ontological assumptions, for me, the best research design would be multi-paradigmatic research (Taylor, Taylor, & Luitel, 2012; Taylor, 2013) design space. I applied mainly the paradigms of interpretivism, criticalism and postmodernism under multi-paradigmatic research space to serve the ontological and epistemological positions that were discussed earlier. The paradigm of interpretivism enabled me to explore the lived experiences as a student, as a teacher and as a teacher educator about the nature of mathematics, mathematics teaching, curriculum and assessment. The critical paradigm offered me a critical outlook needed to investigate the research problems, to reflect upon my own beliefs and practices and to make my

stories apparent to the readers, and to provide sufficient space for engaging in the actual contexts. The postmodernism paradigm allowed me to use multiple genres for cultivating different aspects of my beliefs about various issues in an artistic way. Hereunder, I have elaborated in more detail about those paradigms, focusing on how I have used them in my study.

Interpretivism

While conceptualizing my research agenda, I was in trouble with the limitations of the conventional ontological and epistemological aspects of research. I found interpretivism appropriate for replacing the hegemony of conventional research that was restricting my thinking and writing in conducting and constructing a research (Luitel, 2012). The paradigm of interpretivism helped me as a researcher to understand and construct a new meaning of the academic culture of mathematics education that we hold. I believed that such new meaning can be drawn by interpreting and reflecting upon my own beliefs, learning and teaching experiences within my culture, based on the context of my own and my contemporaries' thoughts, beliefs, values and associated aspects of the culture. My purpose of the study was to generate a new contextual understanding rather than duplicating the previous established understandings as truth. For this, interpretivism allowed me to provide substantial descriptive of the details that are imperative in contextual understanding (Bryman, 2012).

I used interpretivism which is also as a gateway to develop practical interest as described by Habermas (1972). This was about understanding the environment so that I could interact with it. In my study, the environment was the periphery of mathematics, mathematics classroom, mathematics teachers, mathematics teaching, curriculum and assessment.

Criticalism

The majority of teachers have negative beliefs towards the mathematics and mathematics teaching, especially in developing countries (Golafshani, 2005). The critical perspectives helped me to seek out evidence from the perspectives of power, maintaining a more flexible position as the researcher for investigating power in multiple forms operating from multiple directions, rather than simply as a form of oppression as argued by Stinson and Bullock (2015). I have used both "outward criticality" as well as "internal criticality" (Luitel, 2009) while developing and discussing my narratives. By following outward criticality, I examined the beliefs and practices about the nature of mathematics, pedagogical practices, curriculum and assessment from the perspectives of other than me (such as environment, and culture). Finger pointing to the outward world would not be sufficient for developing transformative lens in my inquiry. So, being an auto ethnographer, internal criticality would be the most appealing part in my study. I used the notion of internal critically to point the fingers to my own beliefs and practices. While being critical to oneself and outward, I attempted to follow the knowledge constitutive interest of Habermas (1972), especially with practical and emancipatory interest. While doing so, I tried to bring different layers of consciousness of my practices with enough self-criticalism keeping in mind that *knowing as critical self-reflection* (Brookfield, 1994).

Postmodernism

It was a challenging task for me, as a novice researcher, to make sense of postmodernism and its uses in my study. With the rise of postmodernism and my awareness of it, I started to learn to think differently about what constitutes *knowing*. Ironically speaking, it might be my 'bias' that has led me to chooses this particular research aiming to examine my own beliefs and practices. However, postmodernism

created a context of doubt, in which all methods are subject to critique but are not automatically rejected as false (Wall, 2008).

As I narrated my life history, critical moments, changes of stories related to my personal and professional experiences, I did not present them in a linear way, just describing in words. I do not believe on *one-size-fits-all* approach in capturing the narratives (Luitel, 2009). So, while presenting my narratives, I emphasized alternative-inclusive logics such as dialectical (synthesis of contrary viewpoints), poetic (capturing ineffability), narrative (diachronic representation of research process) and metaphorical (employing analogies and images to expand conceptual possibilities) logics, which potentially report for a complex nature of knowing, being and valuing. Regarding the uses of various ways of representing, Taylor and Medina (2011) stated that, "the best we can do is 'represent' our thoughts and feelings through various means of communication (e.g., language, art, dance, gesture)" (p.8). While doing so, I used playful, ironic, poetic and metaphorical language together with the aspects of academic language throughout my study to capture the multiple realities of my narratives.

Autoethnography as Methodology

I am a teacher, a teacher educator and a practitioner researcher. Being a teacher, I have to deal with diverse students from various backgrounds at different levels. Being a teacher educator, I engage myself with many teachers on textbook development, teacher education, and many sessions in curriculum and assessment portions. As a practitioner researcher, I am eager to study my own practices so that I can improve in my professional career. I am interested in making my stories of personal and professional experiences public among students, teachers and colleagues believing that re/examining those episodes would help me to improve my practices as

well as to evoke the various issues and possibilities in the field of mathematics education. However, I do not claim that I have improved greatly. I am always in the commune with human (i.e. mathematics teachers, researchers, educators, etc.) in different time and contexts. In this scenario, I believe that autoethnography is the best fit methodology for my study.

Etymologically, the term 'autoethnography' comprises three different words – *auto*, *ethno* and *graphy* – which signify the textual representations of one's personal experiences in his/her cultural context. In this regard, Ellis, Adams, and Bochner (2011) mentioned that, "autoethnography is an approach to research and writing that seeks to describe and systematically analyze personal experience in order to understand cultural experience" (p.1).This presents highly personalized accounts that draw upon the experience of the self (researcher) for the purpose of extending the understanding of human condition. In this approach, the researcher brings such critical context, which describes the personal experiences in order to understand the cultural experience. This approach challenges canonical ways of doing research and representing others (Spry, 2001) and treats research as a political, socially justified and conscious act (Adams & Holman, 2008). I have used the tenets of my autobiography and ethnography to write autoethnography. Thus, as a method, autoethnography is both a process and a product.

In this inquiry, I have used three key features of autoethnographic text: performative, dialogic, and pedagogic enablement (Luitel, 2009). The performative feature of my auto ethnographic text helped me to construct narratives of my experiences of professional-cultural situatedness. I did not use performative texts as to simply offer explanatory information, but I have invited readers for imaginatively and creatively perform my texts in various possible ways. Pedagogic enablement is about

taking the initiation to search the better pedagogical practices all the time. I believed there was/is always enough space for better improvement in any type of educational setting.

I have not only presented my professional life history. As a researcher with the quality of dialogic meaning maker, I have invited the readers and tried to make a creative link with my personal experiences. Here, ethnography is also a method of inquiry, a way of seeing, and a mode of representation in my research. Ethnography includes descriptions of cultural ceremonies, rituals, rites of passage, and daily events and behaviors (Vanderstoep & Johnston, 2009). I, as an auto ethnographer, have thus told my stories about the experiences of/with others from my conscious vantage points. In the context of my research, it is a written representation of a culture that not only described the practices of the culture but also investigated the functions and purposes of those events, described the conditions under which particular behaviors or practices occurred, and suggested some useful alternatives with deeper understanding of the culture.

Therefore, to me, autoethnography is a research methodology by which researchers search the past self-experiences in the existing socio-cultural context. I am with the thoughts of Qutoshi (2015), who argued that autoethnography is one of the most suitable spaces for transformative researchers and to serve the agenda of envisioning a transformative teacher education. In my case, according to the purpose of my inquiry, the activities we perform in mathematics education community – schools, societies, and the environment I am embedded with, are my cultural context. Thus, I come to know that autoethnography provides an avenue for doing something meaningful for self and the world (Ellis & Bochner, 2000). The main aim of choosing autoethnography is a *research as/for transformative professional development* which

enables teachers and teacher educators to become critical, inclusive and creative practitioners of mathematics education (Luitel, et. al, 2012; Taylor, 2015).

Writing Narrative as a Method of Inquiry

I have used the narrative inquiry approach to trace meaningful experiences of my life, from student to teacher and to teacher educator. Since my goal was to develop a deeper understanding of how my personal and professional experiences shaped who I am becoming as a mathematics student, teacher and teacher educator, I have chosen narrative inquiry as a method of inquiry for my study. I believe that telling a story creates more vivid, powerful and memorable images in a listener's mind than does any other means of delivery of the same material. Bochner (2014) argued that the aim of narrative inquiry is to invite readers to go on a voyage with the researcher, one in which the researcher(s) and the readers would be discovering and making something together. People shape their daily lives by stories of who they are, and they interpret their past in terms of these stories. In this sense, a story is a portal through which a person enters the world and by which their experience of the world is interpreted and made personally meaningful (Clandinin & Connelly, 2000).

Throughout my study, I engaged myself in a critical reflection about the meaning of my past, present and possible future experiences as I come to face and develop various beliefs and assumptions towards mathematics, mathematics teaching and learning, curriculum and assessment. Personal reflections also allowed me to envisage better images of mathematics, mathematics pedagogy, curriculum and assessment that I would want to employ and that may be a mirror for the changes and improvement in my professional career. I have used various genres while developing the narratives in my study. Dialectical logic, poetic logic and metaphorical logics were the major ways of expressions in my study.

Dialectical Logics and Use of Slash (/)

Beliefs are not easily measured by quantitative means and different aspects of beliefs may be difficult to distinguish from one another or may interact and affect one another (Smith, 2014). I think the belief system is very complex. I, myself, have come across various situation constructing and deconstructing beliefs about the nature of mathematics, mathematics teaching and learning. In this case, the use of dialectical logic is very appropriate to capture the intact situation. With the help of the different forms of dialectics, I generated an inclusive nature of mathematics as a pure as well as impure knowledge system, which I labeled 'im/pure' nature of mathematics (Luitel, 2013) to capture the different forms simultaneously. Teaching is as re/producing the knowledge. Here, "re/producing" brings two extreme beliefs opposing each other.

The tension between fallible and absolutist nature of mathematics, traditional and constructivist approach of teaching , transferring and transforming as the teachers' roles are supposed to be mitigated through developing the dialectical logics. I have an assumption that dialectical logics would depict the relationship between opposing realities such as dualism/non-dualism, certain/ uncertain, self/other, east/west (Taylor, Taylor, & Luitel, 2012) in the belief system and teaching practices. For this, I found the use of slash (/) to be appropriate in my inquiry.

Poetic Logic

To convey the real milieu and scenario, the linear explanation is not enough. Taking this challenge in mind, I have also used the poetic logic in my study. The poetic metaphors increase the size of the sets of multiple references in comparison with ordinary metaphors, but the fundamental rules of interpretation that govern their meaning need not change (Pietarinen, 2012). In my inquiry, I used poetic metaphors to engage in a considerable amount of referential multiplicity (Lakoff & Johnson,

1980). When I first read Richardson (2000), I realized that I needed to work to relocate myself in my work and to search for my own writing map. I realized that I needed to find ways to express, explore, and examine who I am as a mathematics teacher and how I situate myself in the world in order to reframe my work as a teacher and teacher educator. I realized that her inquiry could inform educational research and it influenced me to explore narrative inquiry with the use of sufficient poetic logic.

Metaphorical Logic

In my study, I have brought lots of discourses on educational issues and put the readers in verisimilitude situations. While doing so, the use of words in explanation of the situation may not be sufficient. For this, I believe, the use of metaphors is appropriate which provides essential ingredients for my study. Lakoff and Johnson (1980) argued that metaphors are of fundamental importance to illuminating meaning because the essence of metaphor becomes thoughtful by experiencing one kind of thing in terms of another. After the uses of metaphors by Lakoff & Johnson (1980), Dyson (2007) and Luitel (2009), I chose to employ metaphors to tell my story of constructing my professional narratives and how my practices changed as a consequence.

Ernest (2010) agued the uses of metaphor to capture the abstract concept of mathematics, and the metaphorical explanation are very strong in teaching and learning. In the case of using metaphorical logic in research, I have used the ideas presented by Luitel and Taylor (2013) –metaphorical logic is not restrained by the literal meaning enshrined in the concepts; instead they help to pursue our understanding beyond bounded literalism.

Setting Quality Standards

Using a multi-paradigmatic research design, the lens for ensuring quality in my research is different from the lens used in positivist research approach. Furthermore, the criteria for quality standards for each paradigm are different as they are influenced by the nature of each research paradigm. Therefore, it is important for me to understand the nature of each research paradigm and its accompanying quality standards. In such type of research, quality standards are very important in monitoring the process of research construction (Guba & Lincoln, 2005).

Feldman (2003) indicated that the study of studying the narratives of oneself, and then connect it to the research literature has a great worth because of the quality and rigor they possess. The quality and rigor of the research capture the readers, who authenticate the literature's believability, credibility and coherence, thereby replace truthfulness as a warrant for validity (Lincoln & Guba, 1989). I have continually brought my stories of beliefs and my professional practices. Being an auto ethnographer, I believe in Reed-Danahay (1997), who suggested that autoethnography is more authentic than straight ethnography because the voice of the insider is assumed to be truer than that of the outsider. The following are the quality standards I set in my study.

Verisimilitude

In literary terms, verisimilitude refers to likeliness of the narratives. Ellis (2004) argued that autoethnographic text achieves the quality of verisimilitude as they evoke a feeling that the experience described is lifelike, believable, and possible. It implies that a reader will be asked to suspend doubt and questions about strength in order to engage with the story. Verisimilitude is of vital importance to the worth of reflective writing (Bullough & Pinnegar, 2001) though that both reader and writer

acknowledge that, at very best, the writing represents a subjective perception of the past events.

As I used my own experiences in terms of narratives, the study challenged me with the degree of connectedness I might evoke in the readers. Therefore, I provided vivid descriptions of my own experiences and detailed information of the places and people involved in my stories, vignettes and conversations. I also made efforts to speak in multiple voices to make my stories more engaging, interesting and evocative. Likewise, I allowed the readers to judge the truthfulness of my stories as to how they appealed to their own experiences or the lives they interact in their settings.

Transferability

Transferability is about the usefulness of the research in similar other educational settings. Bryman (2012) viewed that it is equivalent to external validity and demonstrates a tendency to employ the findings for general purposes. For me, it is not the replication of the study. Ellis (2004) mentioned that a story's usefulness is always being tested, not in the traditional way through random samples of respondents, but by the readers as they determine if a story speaks to them about their experience or about the lives of others they know. As I used stories, vignettes and conversations of my lived experiences throughout the study that believing that they evoke the readers, which could be teachers, teacher educators or even researchers. Therefore, in this study, "transferability" does not mean "generalizability" and the "replication" of the study; it is about the usefulness of the study among other stakeholders in the similar setting.

Critical Reflexivity

Criticalism provided me with opportunities to think critically in viewing my practices as a teacher, and investigate the gradual changes in my beliefs towards the

nature of mathematics and mathematics teaching. Larrivee (2000) mentioned that critical reflection is a distinguishing attribute of reflective practitioners. For this, I acted as a reflective thinker by examining my personals and professional beliefs and practices in teaching and learning. I was guided by three phases of critical reflection as suggested by Brookfield (1990). In the first phase, I identified the taken-for-granted assumptions on my beliefs and practices that underlie my thoughts and action. In the second phase, I assessed those taken-for-granted assumptions in terms of how they related to my practices. In the third phase, I developed new assumptions that were more inclusive and empowering, which helped me to widen my perspectives and thoughts. Therefore, critical reflectivity is one of the quality standards to empower for and envisages better alternatives.

Pedagogical Thoughtfulness

I tried my best to engage myself as a researcher and also as a reader in reflecting critically on our values and beliefs about teaching and learning. Being able to reflect critically on my own beliefs and practices in teaching mathematics engaged me into the act of pedagogical thoughtfulness (Van Manen, 1991) in the hopes that students, teachers and teacher educators will come to realize the importance of being reflective in one's own belief and practices. Understanding the connection of teachers' beliefs and classroom practices also plays a vital role in encouraging the readers to think about the educational issues underpinning their pedagogical practices, which is a human construction (Burton, 1999). For me, a critical consciousness requires teachers to reflect on the effect of their practice and see themselves as agents of change (Howard & Aleman, 2008).

Being Aware of Ethics

Dealing with ethical issues is one of the challenges in autoethnography research. For novice researchers like me, using an autoethnography as a methodology is a daunting task. In every phase of autoethnographic research, I believe there is an ethical backdrop. While conducting this study, I was always aware of my own beliefs and practices and how to capture those epiphanies. While unfolding my various narratives, I decide on what materials I would need to include or exclude, and about the evolving issues of privacy and confidentiality that arose in the writing process.

I recognized the risk of showing myself as a "hero" in my own narratives. In many places, I have made enough attempts to realize my limitations and weaknesses. I was very careful and at times I carefully selected the issues that were relevant in my study. I am a university graduate, a teacher educator, and textbook-developer. Due to my own background, it may influence the ways of listening to others, interpretation and writing. In this context, I have been more critical to myself about my own beliefs and practice.

Chapter Summary

In this chapter, I crafted my path(s) for my research study. I began with my dilemma in my research agenda, dilemma of choosing research methodology, and discussed the intention of my study. I, then, argued the usefulness of the multiparadigmatic research paradigm, autoethnographic research method, and narrative as a process of developing my stories. I then discussed how I attempted to use the multiple genres in my study to capture the complexity of narratives, which were the central part of my study. As an autoethnographer, I made the "measuring rods" public for my readers as a set of quality standards that can be possibly used to

judge my research work. I concluded this chapter with a few ethical concerns that I employed during the research work.

CHAPTER III

MATHEMATICS AS CRYSTAL! MATHEMATICS AS SQUISHY!

This chapter explicitly describes my beliefs about the nature of mathematics. As a student of mathematics at different levels, I have been de/constructing the various beliefs about the nature of mathematics. In this chapter, I address my first research question; *in what ways have my beliefs towards the nature of mathematics been developing from absolutist to fallible, and what sorts of belief system is likely to promote inclusive nature of mathematics?* For this, I present how I viewed mathematics as an absolute body of knowledge at the beginning, and how I shifted from one notion of mathematics to another. The narratives of my shift from the absolutist view of mathematics towards the fallible nature and beyond have been captured believing that stories could provide meaningful opportunities to make sense of lived experiences on the nature of mathematics and to generate meanings and alternative perspectives on the nature of mathematics that influence (my) behaviors and practices in various ways in teaching mathematics.

There are nine sections in this chapter; Encountering Formal Mathematics: A Game of Numbers, Welcoming Geometry in the Family of Mathematics, Mathematics as a Problem Solving Game, Useful Mathematics or/and "Imaginative" Mathematics, Mathematics: It Is Unchangeable and You Will Apply Them in Future, Assessing My Journey With the Absolutist Nature of Mathematics, Contradictions in Mathematical Knowledge, Conventional Mathematics Versus "Reform Oriented" Mathematics, Beyond "Either-Or" Category: Inclusive Nature of Mathematics.

Encountering Formal Mathematics: A Game of Numbers

"I know all mathematics. I know from one to hundred." I still remember those days replying to my parents when they asked me what subject was easy for you. "Oh, mathematics is the study of counting from *one to hundred*." This was the belief about mathematics that I clung to in my life at the beginning. This belief of mathematics was slowly developed as an image of *mathematics as a collection of numbers*". If I repeatedly pronounced the numbers in a rhythmic way, I would be considered a brilliant student. At that stage, learning mathematics was just memorizing the number pattern. I did not know what “one” exactly indicated. It meant there were no practices of teaching numbers with the association of objects. Now, I reflect on those days. Was that learning? If a student can pronounce one, two, ….,up to hundred, can we consider it effective learning? In my understanding, until the students can count the objects and be able to say the number of objects by counting them, we cannot consider that as learning.

Now, I came to realize that the early days of my learning went meaningless. The activities I was involved were more "reciting" rather than "counting". Cobb and Steffe (2011) stated that, "when we say a child counts, we mean the child coordinates the production of a sequence of number words with the production of a sequence of unit items" (p. 25). May be such incidents in my early mind compelled me to compromise in my learning throughout my schooling with meaningless mathematics learning.

Again, after some years, I encountered with some other images of mathematics; mathematics as a subject of combination of four fundamental operations (Addition, Subtraction, Multiplication and Division). I used to think that the seniors would have to spend hours in calculating larger numbers. After some

time, I was able to recite the multiplication table from 1 to 10. I would think that maybe my seniors would have to know the multiplication table up to 25 or 30 and the teacher should know up to 100 or more. The mathematics teachers are so talented because they can solve problems with large numbers on addition, subtraction, multiplication and division. One day, I will also reach the same height performing such behaviors. This is how I got convinced. My childish mind was thinking that mathematics was all about numbers and their basic operations. Platonists regard mathematical statements as descriptive of an empire of mind-independent abstract objects such as numbers and sets. Deheane (2011) argued on the importance of number senses. He further mentioned that, "the number sense that we inherit from our evolutionary history plays the role of a germ favoring the emergence of more advanced mathematical abilities" (p. 29). If we see the history of mathematics, it has started from numbers and their uses. The initial belief I held regarding mathematics as a collection of numbers might be common in many cases as we introduce numbers in school mathematics curricula at the beginning of school education.

Welcoming Geometry in the Family of Mathematics

It could be a day in 1993. I was a student of grade five. On the first day of geometry class, my mathematics teacher gave a bundle of home assignments of memorizing all the definitions, facts and postulates in geometry before he made any discussion in the class. We were asked to read the types of angles and triangles with their properties. There were many texts in the book. I tried a lot to memorize all the definitions and properties till late night. The difficult part was that I had not got any sense of the texts I was reading. I could not think of the teachers' decision as wrong or right. The next day, he asked us to recall and tell all the definitions, facts and postulates one by one. I could not recall them ditto as they were in the textbook. I

tried on my own. But the teacher told me not to miss even a single word while giving the definition. The majority of our class could not reproduce the definitions. We were punished for that. As far as I remember, this was the first corporal punishment I got in my schooling. If I were able to reproduce, whatever I had learnt by rote learning, in front of my math teacher, I would be considered a good student. I could not reproduce the definitions and properties in the class, so the teacher marked me as a weak student.

It was the striking moment for me and I asked myself: is mathematics a body of knowledge presented in the textbooks? Can't I express my understandings in my own way? Does learning geometry only mean memorizing the facts, postulates and definitions? Does discussion not have significant roles in shaping mathematical knowledge and internalize them? I took geometry (as a subject) as a collection of information. As I presented before, my initial days of geometry class began with the definitions and postulates. What are points? Where do they exit? Where are the lines? Are there lines inside the classroom? Such questions were unanswerable to me. When I read Karl J. Smith's (2012) seminal book, *The Nature of Mathematics,* I found his reservations on the well-accepted ways of defining points and lines. He mentioned that the definitions of points and lines are not satisfactory because they involve other terms that are not defined. As a teacher, I struggled enough to show points and lines in the classroom. In this regard, Smith (2012) wrote, "We often draw physical models or pictures to represent these concepts; however, we must be careful not to try to prove assertions by looking at pictures, since a picture may contain hidden assumptions or ambiguities" (p. 332).

School geometry, as it is usually taken, is a more or less simplified version of the Euclidean geometry (Marjanovi´c, 2007). The deep-seated culture on remaining

silence on the foundation of mathematics, often accepted as mathematical axioms, promoted the view that mathematical knowledge are unquestionable. The overemphasis on Euclidean nature of mathematics in school level might have created such situations among mathematics learners. Today, many of us argue that geometry is one of the most "useful portions" of school mathematics, and it is believed that it can be easily discussed in the classroom with the help of manipulatives. Here, the useful portion means those mathematical ideas that can be directly linked with out-of-school mathematical activities, and that can be used in our day-to-day activities. But when I was a school student, I could not develop images of geometry as a useful subject. My beliefs of geometry as an abstract segment led me towards a difficult situation in my learning of geometry. I was very "weak" in school geometry. I could not solve geometrical problems as much as I could arithmetic and algebraic problems. The same image (geometry is to remember) dominated my learning for many years. Now, I see the defect in the teaching process, and it ultimately led me to realize the unsatisfactory performance of the teacher. Now I can see many points and lines around me. Why did my teacher not give examples of points and lines from the class?

In our context, the empirical study has also shown poor performance in geometry. For example, NASA (2011) reported that the students' achievement is very weak in the portion of geometry (37 out of 100). The report stated that, "the students are much weaker in reasoning, problem solving, plotting, proving the theory or formula, and constructing the shape and figures" (p. 52). It further showed that students are performing weak not only on the basis of grade they carry, but also from the perspectives of the utility of school geometry.

When I go back in those episodes of my student life, I critique from both perspectives: outward as well as inward criticalities. In the outward criticality, I tried to assess the problems that exist exclusively outside of me. But, at the same time, I realized that pointing fingers to the outer environment is not sufficient for me to develop an agency towards the transformative journey. So, I began to assess my own assumptions, values and beliefs through critical lenses. In this regard, I used the perspectives of Kincheloe (2006) that critical self-reflection offers an understanding of the significance of socio-cultural and socio-historical process of the construction of a dynamic self. I could not be aware of the teacher's ways of dealing with the basic geometric ideas. His/Her ideas were mind-centric rather than object-centric. At the same time, I did not try myself exploring the ideas from the text and searching geometric concepts in the objects. The construction of the geometrical knowledge should be acquired via manipulating spatial objects (concrete experience), brainstorming (imagery concept) and writing symbolic solutions (Hwan et al., 2009). I do not remember any day of my schooling where teachers used manipulatives in the geometry classes.

In the context of Nepal, I partially agree with Usiskin (1982) when he stated that many students fail to grasp key concepts in geometry, and leave geometry class without learning basic terminology. In my case also, I took geometry portion as thorny in my schooling. I frequently heard from my elders that geometry is one of the most difficult sections in the school level. This myth was so strong in the case of geometry: "*No one can prove the theorem of geometry in the class."* The senior brothers gossiped in the canteen. "*Oh my god, how difficult is geometry? What are proofs and why do we need them?"* I suddenly asked my seniors. One of my seniors (who was able to make an impression of himself as a good student) replied me in a

humorous way: "*Proofs are important and you must memorize the steps of the proofs of important theorems to acquire good marks in the exams*." We all laughed.

In geometry teaching, Van Hiele (1980) contributed significantly focusing on the levels of geometry learning. He believed that writing proofs requires thinking at a comparatively high level, and that many students need to have more experiences in thinking at lower levels before learning formal geometric concepts. If a student is not able to grasp the knowledge of lower level, s/he cannot learn higher level concepts. Ma (2015) argued that discovering the implications of the van Hiele theory for elementary school students is very important. It seems that the levels investigated by Hiele are too hierarchical with some specific features. I think Hiele's levels are useful in teaching and learning geometry for those teachers who believe that more linear way of teaching works in school geometry.

On the other hand, I think the overemphasis on hierarchical ways of knowing may not help to create empowering image for school geometry. It may lead towards the false notion of *globalisation as universalisation* that many Nepali teachers and educators tend to have (Luitel & Taylor, 2010). I have a deep-seated desire to create an inclusive space in teaching and learning that allows both universalism and contextualism to operate in synergistic ways. In this context, I think we need to nurture the possible local approaches in teaching and learning that may create helpful and empowering images towards school geometry. Luitel and Taylor (2013) have explicitly discussed the unhelpful deductive logic in Nepali education that has curtailed the imaginative and creativities aspects of teachers and students. For cultivating imaginative and creative aspects of the students, incorporation of local and cultural practices may be helpful in the case of Nepal, where multi-cultural practices exist even in a small territory.

Mathematics as a Problem Solving Game

It was the time when I was a student in grade six. I stood first in grade five. When I passed grade five with a good recognition from a primary school, I went to a secondary school for the study of grade six. There was only one secondary school in that locality in which many students from different primary schools would come to enroll. There were many toppers from five primary schools in grade six at the secondary school. Thus, there used to be high competition among the students. During the time of lower secondary level study, our mathematics teacher was very demanding in the sense that he would expect all home assignments on time. I spent most of the time solving mathematical problems at home that was assigned as homework. The lengthy solutions to algebra and arithmetic problems were really challenging for me since I (we) did not have access to calculators at that time.

The efforts I made to show "smartness" in mathematics classes by solving almost all the mathematical problems created an image of mathematics as an algorithmic problem solving game in which the problems are solved in mechanical ways. It was when I spent a considerable time on solving routine mathematical problems. There were many more mathematical problems - focusing on algorithmic process to get right answers – in the textbooks. But, I found that majority of the problems were not taken from our real life situations. These contexts compelled me to construct yet another belief - the main aim of solving problem was to get the correct answer. Restivo and Bauchspies (2006) mentioned that the algorithmic genre of pure mathematics is identified with a set of rules, formulae and procedures that can be used to solve 'problems' in mathematics. The notion of algorithmic genre was dominant in the school level mathematics. The aim of algorithmic genre was to develop students as mathematicians. Now, the question is: are we making all students mathematicians?

What should be the goal of teaching mathematics in the school level – mathematics for all (Gutstein, 2006) or mathematics for some?

There is a view that mathematics is for problem solving (i.e. algorithmic problem solving). Problem solving is not only a goal of learning mathematics but also a major means of doing so (NCTM, 2000). But, here the notion of problem solving is different from the notion of mechanical problem solving that I experienced during my schooling. The problem solving is not only a skill to be taught and used in mathematics but also the one that can be carried over to "everyday problems" or decision making situations, thereby serving a person throughout life (NCTM, 2000). NCTM states that problem solving does not mean only getting the correct answer to un-contextual problem, but it should also be a meaningful solution to the problems related to the daily life context. A problem is not truly solved unless the learner understands what s/he has done and knows why her/his actions are appropriate (Welch, Brownell & Sheridan, 1999).

I came to understand that there are various problem solving approaches beside the mechanical ways of solving. George Polya (1945), one of the influential contributors in the field of problem solving, discussed the heuristic ways of problem solving in which self-discovery approach is at the centre. Regarding the mathematical problems, Gates (2015) argued that, “we should make it explicit that the act of engaging in problem solving, asking questions examining data, etc., is itself emancipatory and therefore a challenge to, classrooms, curriculum, pedagogy and assessment the authoritarian nature of schools” (p. 50). So, I think it is urgent to develop the conceptual ways of problem solving, and thus promote the self-discovery notion for mathematical problems.

Later on, I came to reflect on what the problems are precisely in mathematics. Yes, there are assorted problems in our real life. They often exist in our day to day practice. My conjecture here is how the problems that we do in mathematics class help us tackle daily problems of our lives. The principal aim of problem solving in mathematics is considered as to make students logical and critical. Do the students who are good at academic (formal) mathematics seem to be more logical and critical in comparison to low performer in problem solving strategies? I have qualms on this issue. I can partially agree with the aim of problem solving, that is to foster logical and critical abilities within the students, but on the other hand, I raise questions on the nature of problems that are being practiced in our mathematics classes. Why are the problems not taken from the social context? Why does the noteworthy gap between the school learning and out of school learning in mathematics exist? So, I believe that the problems are not relevant, not practical, not taken from our society. The beliefs that mathematical problems are taken from outside our context, may be from other countries. In this regard, I quote Luitel (2009), where he expressed the dominant image of Nepali students*: mathematics as a foreign subject*. Such disempowering image about the nature of mathematics among Nepali students may not be able to create the senses of awareness in mathematics.

Useful Mathematics or/and "Imaginative" Mathematics

As I discussed in the previous section, I was aware of the conventional notion of problem solving and the relatively newer perspectives of problem solving in mathematics. I now advocate that the mathematical problems in school level should be related to our context, and it should be taken from day-to-day practices of human culture. But, I experienced the critical moment where I took mathematics for a nonsensical game.

It was some day when I was a student of grade eight. The teacher entered the class and wrote with a piece of chalk on a tattered blackboard "*Unitary Method*". In a regular fashion, the teacher started to lecture on the topic.

Unitary Method is very important in our life. The problems are very practical and interesting….We first need to find the value of unit, then go further with calculation.…

I was listening carefully to the teacher. On that day, I was more excited about the topic as it was one of the most favorite topics to me. One of my friends, who usually used to come with funny questions, asked one of the kinds to the teacher.

Sir, do you think the problems of unitary method are practical in daily life?

"*Of course!*" the teacher replied instantly.

The student further argued;

Sir, 20 men can build a house in 40 days.

1 man can build a house in (20 ×40) days.

400 men can build a house in $\frac{20 \times 40}{400}$ *= 2 days.*

Is this practical? Can 400 men build a house in 2 days?

We all laughed at once.

"Don't ask such silly questions. Doesn't your mind think of some rational questions?" the teacher angrily told him. We all remained silent.

We could not speak in front of the teacher. The other students were celebrating happiness silently as he (the questioner) was scolded. Though the teacher did not respond to him positively, I was compelled to think about his query. It is impossible to build a house in two-three days though we provide as many workers as we can and as many resources as needed. However, there does not seem to be any mathematical error in the example presented by the "stupid" student. Few questions arose in my

mind: is learning mathematics only solving mathematical problems? Is the ultimate goal of problem solving getting the correct answer through the valid mathematical procedures? Cannot we apply the mathematical solution in our daily activities? Does a good mathematical problem solver turn to be a good decision maker in life? I think it is romantic to say that such school mathematics is largely useful in our life. I do agree there are beauties in mathematical patterns and mathematical knowledge. It is not necessary that all beautiful patterns are useful in our life. While observing the above case, I have two opposing queries: "mathematical knowledge is for us" or "we are for mathematics".

When I viewed back to my school life, I felt that our school mathematics has made students 'enforced customers' where they had no choice but to accept one particular view about the nature of mathematics. In this regard, Bishop, Seah and Chin (2003) advocated that students have beliefs about mathematics that formal learning has little to do with practical realities. This again arises queries that why formal mathematics does not address the real thinking of the students? Does mathematics have such nature? Are we minimizing the gap of school mathematics and out of school mathematics this way? The school mathematics needs to develop mathematics literacy in the students. In this regard, I believe the constructivist nature of mathematics (Ernest, 1991, 1994, 2015) could be one of the ways to empower students with the knowledge of mathematics.

When I read the book *Street Mathematics and School Mathematics*, by Nunes, Schliemann and Carraher (1993), I found the writers' impressive expressions about formal and informal mathematics and the place of out-of-school mathematics in the society. By this, the authors meant that the informal mathematics is powerful and popular in day-to-day life in the societies. The relation between street mathematics

and school mathematics should be close; otherwise school mathematics loses its popularity. The above narrative on the unitary method explicitly created a space in my mind about the nature of mathematics that exists in the textbooks, but does not exist outside the classroom.

Mathematics: It is Unchangeable and You Will Apply Them in Future

It could be any day of 1997. It was time after my S.L.C. examination. I was in grassland grazing the goats. This was my routine house job besides the study during my schooling. My attention was drawn by the news on the radio carried by a person passing by. "*The S.L.C. result published today*." I heard it on the radio. I hurriedly gathered the goats and went home. I shared the news with my parents. I went to the local shop where there was a large gathering of people expecting the arrival of the person who would bring newspapers from the town. I accompanied them and waited till late evening but could not get any further information. I came home back. I could not enjoy my dinner. I went to my bed but could not sleep.

The next day, I went to the local market expecting the newspaper. I along with some friends spent the whole day. We all were so anxious to know our results. One of the villagers came with a newspaper. We were so happy. The people gathered within a few minutes. I got my turn after an hour. There was only one symbol number under the category of first division from our school, and it was mine. It was my aim. I was so happy. I was the third person from our school who obtained the first division marks in its history of fourteen years.

I decided to go into town for my higher study. I came to Banepa, a local city near my village. I admitted in an education college majoring in Mathematics. I wanted to develop my career as an influential mathematics teacher expecting that I would get many experienced teachers in the college, which we had lacked in the school level.

Though I was a good algorithmic problem solver, I was not satisfied with the ways I learnt mathematics in the school level. I wanted to learn mathematics with its (daily life) applications. I came to college with a high level of enthusiasm.

It was the first day in my college. I was carrying books in my bag. I sat on the first bench. Nobody was familiar with me. A teacher entered the classroom. Luckily, he was a mathematics teacher. He wrote "*Calculus"* on the whiteboard. He further explained the importance of calculus in higher level mathematics.

"*This is the beginning of higher mathematics. The subject of "Calculus" is one of the most influential branches of mathematics. It provides numerous services in almost all the fields such as Business, Economics, Engineering and so on. You will know them in future. Calculus begins with the concept of limit and derivatives. Today, we are going to discuss what limit is and solve some important problems from the exercises.*

He explained "*limit"* for some minutes and solved a few problems on the board. He asked us to complete the first exercise of *limit*. As the bell went, the class was over and the teacher left the classroom. I was amazed. My expectation was something different. I thought the emphasis would be given on conceptual understating and application of the content. How long shall I wait to know the application of mathematical knowledge? Where is the "future"? There were many questions in my mind. But I was habituated not to ask any questions in front of the teacher. By that time, I had already spent ten years in formal education. Still, I needed to wait to know the applications of mathematical knowledge. It was ambiguous for me. Once again, I realized that my expectation would not be fulfilled from this college as well. Feeling very sad, I returned my room.

Assessing My Journey With the Absolutist Nature of Mathematics

I presented various narratives of my student life till grade twelve focusing on how I viewed mathematics. Out of hundreds episodes of similar experiences, I chose a few of them as illuminating narratives expecting that these are sufficient to capture my beliefs towards school mathematics. I do believe that similar beliefs were constructed in the minds of my contemporaries regarding the nature of school mathematics. Now, I focus my discussions on the beliefs I held for many years, the assumptions behind such beliefs and the shift I made from my long-seated beliefs to some other beliefs.

In almost all the above narratives, one common idea is that mathematical knowledge and truth are entirely exact and indisputable. Such beliefs are dominant in our society. Such beliefs are known as absolutist view of mathematics. Ernest (1991) mentioned that, "the absolutist view is that mathematical truth is absolutely certain, that mathematics is the one and perhaps the only realm of certain, unquestionable and objective knowledge" (p. 3). It is believed that knowledge is represented as a set of propositions providing a set of distinct procedures to be followed. The assumptions behind such claims are the basis of foundationalism (Hersh, 1997). It means there are certain foundations for mathematical knowledge such as axioms and postulates which have been taken as final truths.

Let me discuss the mathematics that we have been learning/teaching in the Nepali education system. Around 2500 years ago, a great mathematician Euclid developed and compiled a series of books as a logical structure in mathematics. This has become the most influential text in the field of mathematics till the end of nineteenth century as the paradigm for establishing mathematical truth and knowledge. Euclid used a priori notion of knowledge which suggests that propositions

are based on the deductive logics. About the Euclidean mathematical knowledge, Ernest (1991) mentioned that, “since logical proof preserves truth and the assumed axioms are self-evident truths, then any theorems derived from them must also be truths” (p. 6). My narratives presented in the above sections are likely to depict that the absolutist nature of mathematics as an indubitable truth is dominant in the school mathematics education in Nepal. One of the reasons could be giving overemphasis on Euclidean mathematics in Nepali mathematics curriculum. We implemented mathematics curriculum in accordance with the nature of mathematics as instrumental in reproducing the Western Modern Worldview, transporting from the British–Indian colonial era, which reigned in neighboring India for many years until the middle of the 20th Century (Luitel, 2013).

When I was in the school level, our math teachers would not allow us to construct our own definition (equivalent definition). I still remember my school days. One day, our math teacher said that definitions are not as public talks given by our political leaders which will change day in and day out. Mathematical knowledge is not like the knowledge of social science which may change with respect to time and context. For me, now, such teachers who advocate mathematical knowledge as a body of objective knowledge are totally guided by the absolutist view. They believe that knowledge as a priori that consists of propositions which are asserted on the basis of reasons alone, without recourse to observations of the world (Sheffler, 1965). For such teachers, construction of knowledge is impossible, axioms and postulates are unquestionable, deductive logics and definitions are used on the basis of pre-established axioms and postulates. The logical assumptions, that are the rules of inference and the logical syntax, are assumed to be part of the underlying principles, and are part of the mechanism needed for the establishments of

knowledge. Thus, logics are assumed to be an unproblematic foundation for the justification of knowledge.

Another assumption on the nature of absolutist mathematics is the ideology of singularity. It promotes the single perspectives on viewing the mathematical reality. Luitel (2009) argues that "the front aspect often depicts mathematical knowledge as a finished and 'singular' best product, thereby separating it from the context of investigation, construction and development, which can be depicted via the back aspect of mathematics" (p. 92). It means, we have neglected the portion that focuses on how mathematical knowledge came into existence. What were the contexts of investigation and construction of such mathematical knowledge? How did it come in this form? Due to the absence of such discourses in mathematics classes, many of Nepali students, including me, were compelled to construct disempowering view of mathematical knowledge as the *god-made-fact.* In my experiences, the belief that mathematical knowledge is entirely different from the body of linguistic or literary knowledge has gained popularities among Nepali learners, assuming that mathematical knowledge could not be altered whereas knowledge related to the literary or humanities domain could easily be altered.

Arriving at this stage I am going to unpack my experiences towards the dominant nature of Nepali school mathematics. As a teacher and teacher educator, constructing beliefs on certain perspectives may in/directly shape our professional practices. There have been several studies involving high school teachers that focus on the interplay between teachers' beliefs and their instructional decisions. Wilson and Cooney (2002) discussed one insightful example from the case of Israel on how a pre-service teacher explained 4/0. According to the authors' example, 4/0 is undefined because division by zero is not allowed. When a researcher asked the

teacher how she would explain why this was so to her students, she responded, “In mathematics we have rules. These rules often do not seem reasonable. When studying mathematics, one has to adopt these rules and operate accordingly.” (Wilson & Cooney, 2000, pp. 138-39). Here, the teacher viewed mathematics as a *bag of unexplainable rules* and she expected her students to memorize those rules and procedures without any queries.

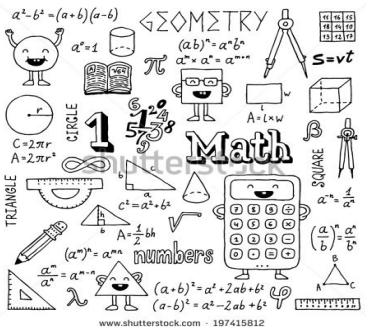
The case of Israel existed in my case too. When I was guided by the absolutist belief of mathematics, my preferences on pedagogical practices was too linear, and I was straightforward to calculating the answers, and focusing on the reproduction of knowledge. I did not welcome the questions from students’ side as my belief was shaped by the view that there were no students’ spaces in the mathematical knowledge. In this case, the teaching process seems to be more mechanical. The notion of getting correct answer following the systematic procedures becomes the dominant principle inside the classroom. The students are taken as passive receivers of knowledge. They think mathematical knowledge was developed by great superman (Ernest, 1991) for which we cannot challenge and question. The only way is to accept them an unquestionable way.

Now, I discuss how I came to know the alternative nature of mathematics in my professional context.

Contradictions in Mathematical Knowledge

It was a day of September, 2007. I was a student of Master level. One of the subjects was Mathematics Education. The facilitator asked us to reflect on our beliefs about the nature mathematics. We got confused. The facilitator then made us easy suggesting us to write a poem, draw a picture or produce some texts capturing our instant thoughts that come to our mind about mathematics. All of us thought for a

while, and started to write something on some sheets of paper. After a few minutes, our facilitator asked us to share our creation. It was very wonderful listening about different creations of our friends. Some shared poems, some wrote statements and some went for producing pictures. I could not bring here the pictures drawn by my friends. But I tried to share two of the pictures that were similar to the creations made by our friends. On one sheet of the paper, the picture of human head was drawn, and the mathematics was written on the outer surface of the human mind. On the other sheet of the paper, one of our friends wrote formula, drew various geometrical shapes and mathematical instruments. Our facilitator asked them to explain the pictures.



The person who drew mathematics as the human mind explained the nature of mathematics as the creation of human brain. According to him, mathematical knowledge is creation of human mind, independent from the societal practices, and very "talented" people can invent such mathematical knowledge.

The second person who expressed his views about the nature of mathematics as the collection of formula, pictures and geometrical instrument explained mathematical as the body of knowledge to be memorized and re/produced. According to him, there are bundles of mathematical patterns, knowledge, theorems and problems already explored and existing in the world.

I also tried to come up with a very short statement about mathematics. I wrote mathematics as an exact science. My thoughts were with the second person in the above discussion who argued mathematics as a collection of unchangeable truths.

Our course facilitator listened to us carefully. He encouraged us to share events that helped to shape such beliefs. In almost all creations (pictures, statements, poems, etc.), there was a common thread. As we all have brought up from similar educational environments, our thoughts were with the absolutist view of mathematics. Today, I recall those episodes, thinking how deep-seated beliefs about absolutist version of mathematics were formed among all the students of mathematics education including both prospective mathematics teachers and in-service teachers.

When the discussion was over, our facilitator shared a paper entitled *A Critique of Absolutist Philosophies of Mathematics,* written by Ernest (1991), and asked us to go through the paper. We went through a few pages, struggled to make sense of the words and sentences. After scanning the paper, the engaging discussion occurred in the class. It was the turning moment in my professional life in terms of viewing the mathematical reality. The author has explicitly presented the limitations of narrowly conceived nature of mathematics and how the societal practices gave rise to create alternative perspectives on viewing the mathematical knowledge and truths. The alternate perspective on viewing mathematics is from the lens of fallibilism. In this regard, Ernest (1991) mentioned that the fallibilist view is such a view that takes mathematical truth as corrigible, and can be regarded as being above revision and correction. The engaging discussions with the contextual examples from our community helped a lot to make sense of fallible mathematical knowledge and truth. Many of us shared our experiences of local measuring system, time calculations strategies with the help of sun and shadow, base 20 systems in counting, etc. After

discussing our mathematical practices of our daily life, our facilitator drew our attention towards how fallible nature came into existence in the field of the nature of mathematics.

As time passed by, some mathematical knowledge turned into contradiction. Russell was able to show that Frege's system was inconsistent in 1902. The problem lay in Frege's *Fifth Basic Law*, which allows a set to be created from the extension of any concept, and for concepts or properties to be applied to this set (Furth, 1964, as cited in Ernest, 1998). Russell produced his well-known paradox by defining the property of not being an element of itself. Godel's first incompleteness theorem, published in 1931, showed that proof is not adequate to demonstrate all truths. These events eventually created lots of spaces that there are truths of mathematics not captured by the systems of the logics. Other contradictions also emerged in the theory of sets, the theory of functions and the Euclidean's fifth postulates. The famous *liar paradox* also indicated going beyond the classical theory of binary approaches of defining truth value in (mathematical) statements. Such discourses in the academia and in the society have, of course, raised serious concerns about the absolutist view of mathematical knowledge.

During the course of time (year 2007/8), I got an opportunity to interact with the culture of mature of mathematics, *Ethnomathematics*. It was the time when I was struggling to explore the examples of mathematical knowledge in our communities from the perspectives of fallibilist view of mathematics. It was the time of happiness when I read D'Ambrosio's (1990, 2015) work in Ethnomathematics. Nepal is a rich country to explore local mathematical knowledge, where many ethnic groups (such as Tamang, Newari, Rai) have rich mathematical practices in their day-to-day life world. The research conducted by KUSOED and UNESCO (2008) in Tamang and Gopali

community proposed a broader understanding of the nature of mathematics in which mathematics is understood as arising from familiar cultural activities. This research made remarkable arguments towards the understanding of nature and application of mathematics in rural setting by linking the arithmetical operations (such as addition, subtraction, multiplication, division, time and work, ratio and proportion) with the production and business of potatoes and the basic geometrical knowledge with the design of the plot and mapping the queue of potato plants.

D'Ambrosio (1990) defines ethno as related to distinct cultural groups identified by cultural traditions, codes, symbols, myths, and specific ways of reasoning and inferring. When I encountered such new and widely discussed nature of mathematics, I realized that mathematical knowledge were context-bound and might not be true all the time. Such shift in my belief helped me a lot to modify my classroom practices, yet many questions emerged in my mind. Why did not I create discussions about mathematical knowledge from multiple ways in the classroom and encourage the students to think beyond the formal mathematical framework? Rosa and Orey (2010) also discussed that ethnomathematics may be considered as the way for various cultural groups to examine how both mathematical ideas and mathematical practices are processed and used in the daily activities.

In the recent years, mathematicians and mathematics educators have started to discuss "out of the box". If mathematical knowledge is always certain, and all its theorems remain certain forever, how contradictions (i.e., falsehoods) have been appearing? Since there was no mistake about the appearance of these contradictions, something must have been wrong in the foundations of mathematics. Such contradictions in mathematics have opened the door for discussion on the existing teaching/learning procedures. If mathematical knowledge is context-bounded and not

true all the time, why do we not create the rich environments for discussion in mathematical knowledge from multiple ways inside/outside the classroom and encourage students to think beyond the formal mathematical framework?

Due to the inadequacy of absolutism in addressing the problem of exclusion and ever-growing discussion on contextualization of mathematical knowledge and truth, the fallibilist approach in the field of mathematics created a wide space in my personal and professional contexts. I came to realize that the fallibilist view has been discussed in two forms, one positive and the other negative. The negative form concerns the rejection of absolutism. In this form, the mathematical knowledge is taken as not absolute truth, and does not have absolute validity. The positive form is that mathematical knowledge is corrigible and continually open to revision. Here, as a teacher and teacher educator, I believe the healthy way is to advocate the positive form of fallibilist view of mathematics. According to Popper (1979),

> There are no authoritative sources of knowledge and no source is particularly reliable. Everything is welcome as a source of inspiration, including intuition. But nothing is secure, and we are all fallible. (as cited in Ernest, 1991, p. 18)

During the course of time, I got opportunities to interact with a few number of teachers who believed that the fallibilist nature of mathematics also exists in the globe of nature of mathematics. The teachers, who believe the nature of mathematics as fallibilist knowledge system, have different pedagogical practices, such as they are likely to respect students' voice and encourage for alternative process of solving problems and for equivalent definitions. Most probably they believe that a new task of learning mathematics is not to seek unquestionable truth but to give an account of mathematical knowledge, as is it really fallible, corrigible, tentative and evolving, as is every other kind of human knowledge (Hersh, 1979).

Conventional Mathematics Versus "Reform Oriented[2]" Mathematics

It was one of the most awaited days not only for me as a student of mathematics education but also for the mathematics educators in Nepal. The day was 27th September, 2012. The umbrella organization in the field of mathematics education in Nepal was organizing its first ever "National Conference in Mathematics Education". The remarkable achievement of this conference was to bring the president of the International Congress in Mathematics Education (ICME) to Nepal. I feel myself lucky to be a part of this conference – not only as a presenter - but also as one of the active members of the organization.

I submitted an abstract for the presentation. The selection committee approved my abstract for presentation, and sent an e-mail to write the full paper and to prepare presentation slides for twenty minutes. "Your presentation will be in the parallel session", the e-mail ended with this sentence. Though I was interested to share among all the participants as one of the key presentations, I could not. I consoled myself - it may be due to my ideas in the abstract- the ideas which do not meet the standards to share among all or the presenter does not deserve this. Anyway, it was a good platform in itself and I need to try in the days to come for the better platform. The opportunity to present in a good platform is obviously good news. The next step was related to the matter and the way I was going to present. I think everyone has to undergo such trail in the initial days of the career. I wanted to present in an effective way in order to grab the participants' attention. I thought for some days, spent some hours with Google, especially to know the effective ways of presentation. However,

[2]I have used the term "Reform-oriented" to present the views of fallibilist nature of mathematics with the focus on collaborative and constructivist teaching methods, and the possible uses of localizing the curriculum and practicing the continuous assessment strategies.

Google could not help me much that time. I heard the quotation, “Creativity comes from the human mind rather than googling”.

Suddenly, some ideas emerged in my mind. I reflected, *‘What happens if we present our ideas in a dialogue form? A television show seems popular because there are dialogues. The theater is popular due to the ways they present in a natural setting. Yes! Why don’t we use this idea in our academic presentation for our lively presence in the academia? For this, I need a partner and need to identify the focus.’* I immediately made a call to one of my close friends, who knew well about this conference and was working actively to make it a success. I shared the ideas. He seemed happy to be a co-presenter. I thanked him. He told me in a tattered voice, *“Binod,……..You have submitted the abstract and received the notification. How can you change it now?”“Oh! It is true. The committee may not allow me to change my focus. But I will try to convince them.”* I replied. I immediately made a call to my Professor “Dr. Helpful” (who is one of the members in the decision making body) and he showed a green signal to go further. Thank God! I felt safe. I, along with the co-presenter, spent many hours in different settings to finalize the presentation and we did. Later, I realized that it was one of the examples of “theory of emergence” – I may amend the ideas once I begin.

One day before the conference, Dr. Helpful made a call. “*Binod Ji, there is good news for you. One of the keynote speakers from Ministry of Education has just called me with apology that he cannot present in the conference. I will try my best to reschedule your presentation in place of this key note if you come up with very good preparation”,* He said.

Hurray! That was what we wanted. I immediately called my partner and we decided to meet within an hour to practice our presentation. We practiced it, recorded

our presentation, listened twice, and found some of the errors, which needed improvement.

The long awaited day came. The opening ceremony was finished. Our turn came. We two took our position on the floor to proceed the presentation - Mr. Conventional and Mr. Reform-oriented, as spokespersons of two associations; "Association of Conventional Teachers of Mathematics", and "Association of Reform-oriented (constructivist) Teachers of Mathematics" respectively.

Mr. Conventional: *Good morning all of you. I am "Mr. Conventional", spokesperson of "Association of Conventional Teachers of Mathematics". This is one of the oldest institutions working in the field of mathematics education. It was established to promote the views of famous physicist and mathematician, Euclid. So, we are very much closer to Euclidean notion of mathematics.*

Mr. Reform-oriented: *Good morning all of you. I am "Mr. Reform-oriented", spokesperson of "Association of Reform-oriented Teachers of Mathematics". I also worked together with Mr. Conventional for a long time. But, later, I could not continue working together due to the path of transformation that occurred in my teaching career. So, I joined the other association, which was established to promote the views of progressive philosophers and educators (such as Dewey 1976, Hersh, 1979, 2006; Ernest, 1991, 2013; D'Ambrosio, 1990, 2015; Luitel, 2013).As a member of this organization, I always seek ways for empowering students through school education in general and through mathematics education in particular.*

What do we discuss today, Mr. Conventional?

Mr. Conventional: *Well, Mr. Reform-oriented, let me put our institutional standpoint on mathematics at first. We believe that mathematics is a challenging subject. It is a pure body of knowledge. Mathematical truth is absolutely certain, that mathematics is*

the one and perhaps the only empire of certain, unquestionable and objective knowledge. The validity of mathematics derives from the conditions which determine the meaning of the mathematical concepts, and that the propositions of mathematics are therefore essentially 'true by definition'. We are much guided by formalism, structuralism, reductionism, absolutism, Platonism, conventionalism, intuitionalism, empiricism etc.

What about your beliefs?

Mr. Reform-oriented: *Well, Mr. Conventional, for me and my association; mathematical truth is corrigible, uncertain and questionable. So, it is a subjective knowledge. We believe that there are no authoritative sources of knowledge. The sources of mathematical knowledge are the human cultures and practices, which is not the unique all the time. We should welcome every perspective as a source of inspiration. Nothing in the world including mathematical knowledge is secure, and we are all fallible. We are much influenced by constructivism, criticalism, post modernism, complexity theory, etc.*

Now, what do you think about teaching and learning mathematics?

Mr. Conventional: *Well, as mathematics is a subject of elite people, only the gifted students can learn it. Memorization of facts, postulates, theorems and formulas are very important in mathematics learning. It is all about mechanical use of those things to get the single correct answer after computation. It further deals with quantities and forms with certain knowledge as a mental construct, done by an individual in isolation.*

I do believe that you do agree with me in this regard, don't you?

Mr. Reform-oriented: *I am sorry Mr. conventional. I have some reservations in your thinking. I don't think mathematics is for elite people only. Mathematics should be for*

active and creative citizenry. It is not important to memorize all those things which you stated before as Einstein's one of the famous saying states: "Never memorize what you can look up in a book". For our organization, the important thing is to engage learners in mathematical activities to construct some mathematical knowledge related to real-world problems. We believe that mathematics learning is a social activity and the mathematical knowledge is obtained through interaction in the community of learners.

Mr. Conventional: *Oh! Mr. Reform-oriented, if so, what do you expect from teachers' side? What are the students' roles then?*

Mr. Reform-oriented: *Well, as a reform-oriented teacher, I act as a facilitator. As a facilitator, my main duty is to create "rich environment" for learning mathematics. Reform-oriented teacher always invites students to set specific goals within the framework of what is being taught, provides alternates for activities and assignments that capture various interests and goals of the students, and encourage students to assess what they learn. The students are viewed as active learners. In our practice, students learn to take responsibility for monitoring, adjusting, self-questioning, and questioning each other.*

Let me know about your assumption regarding this.

Mr. Conventional: *Certainly not! How is mathematics teaching possible without being an authoritative teacher? A teacher is expected to know everything that s/he teaches. So, the teacher should provide clear-cut and step-by-step demonstration of the solution. As we are guided by behaviorism, mathematics is to be taught through drills and practices and the students receive the mathematical knowledge passively as taken-for-granted maintaining silence in classroom. We consider textbooks and the teachers as the ultimate authority of knowledge from where the answers to all*

mathematical problems are known and found. From this, I can easily evaluate the students' achievement.

Mr. Reform-oriented: *I wonder how you evaluate your students' performance.*

Mr. Conventional: *It's simple. I conduct a paper-pencil test. My students need to take a written test in the specified period. I provide routine problems from the textbooks that are already practiced. I then check their answer-sheets and provide score on their achievements for certification.*

Do you have any different ideas in this matter?

Mr. Reform-oriented: *I have a different view on assessment. I believe assessment should foster a sense of "cooperation" rather than "competition". Therefore, assessment does not only mean to provide arithmetic scores rather it aims at providing information that will help make decisions concerning remediation, enrichment, selection, exceptionality, progress and certification.*

Mr. Conventional: *It sounds good but I think it is not possible to implement in the context we work.*

Mr. Reform-oriented: *I respect the challenges you have faced. However, the thing we need to keep in mind is "Even a long journey begins with a single step".*

Mr. Conventional: *It's fine. I put these views in the next meeting of my association. See you later.*

Mr. Reform-oriented: *See you later.*

"Thank you for your distinct and energetic presentation." The master of ceremony said. We went back to our seats.

The presentation delivered in the seminar aims to bring the existence of two distinct cultures within our society, the arts and the sciences, which was introduced by physicist C. P. Snow from Cambridge University and was further illuminated in *The*

Two Cultures, a Second Look (2012), as the images of mathematics. These two distinct cultures have own standpoints in promoting and improving teaching and learning of mathematics through different approaches. The one who believes society as an entity of pure natural science takes mathematics as a pure body of knowledge, memorization of facts as well as the ability to follow rules are the students' role (Hiebert, 2003), and providing clear-cut and step-by-step demonstration are the teachers' duty. In this approach, teachers advocate behaviorist approach as taken for granted, and the textbooks are taken as the ultimate authority from where "the answers to all mathematical problems are known and found" (Smith, 1996). The paper pencil test measures the memorization of the facts and focuses on "routine problems".

On the other hand, Snow (2012) believes cultures as an art and assumes that knowledge can be constructed. It aims at assisting students in utilizing their own unique backgrounds and experiences to develop a personal understanding of mathematical situations. This is known as constructivism where students get involved in a new task with prior knowledge, assimilate new information, and, subsequently, construct their own meaning (Amit & Fried, 2008). As children construct their own understanding based on the relationship among prior knowledge, existing ideas, and new experiences, the facilitator should encourage "to construct with new ideas, to work at fitting them into existing networks, and to challenge their own ideas and those of others" (Van De Walle, 2007). In this approach, it is widely accepted that the learners should herself/himself actively explore mathematical concepts in order to build necessary structures of understanding. In doing so, teaching mathematics should be reconceived as the provision of meaningful problems designed to encourage and facilitate constructive processes acting *teachers as researchers* as discussed by Cobb and Steffe (2011) and Kincheloe (2012).

Looking from the perspectives of keeping the nature of mathematics at the centre, the mathematics teachers and the large community of mathematics had been divided into two parts; believing in the absolutist nature of mathematics and believing in the fallibilist nature of mathematics. Lerman (1990) has discussed the connection and the influences of the beliefs about the nature of mathematics with teaching. Regarding the teachers' views who believe in the absolutist nature of mathematics, Lerman (1990) mentioned that, "Application of that knowledge will, somehow, become possible later, and creativity really occurs only at the frontiers of the growth of mathematical knowledge. It has not even been within the mathematics teacher's experience to be creative in this way" (p. 56). On the other hand, the teachers who believe that mathematical knowledge and truth and fallible, and open for revision, their classroom practices differ from the previous one. In this regard, Lerman (1990) mentioned that, "the mathematical ideas that one is teaching would have originated in a certain time and place as a response to some social need, whether of the individual mathematician or of the wider community, scientific or otherwise" (p. 60).

In the above narrative, I tried to capture the two well-established traditions of the nature of mathematics and their influences in teaching and learning. While, doing so, I limited myself on teachers' beliefs about the nature of mathematics and their influences rather than influences of other constructs.

Beyond "Either-Or" Category: Inclusive Nature of Mathematics

It was a good opportunity for me to reshape my beliefs towards fallible nature of mathematics. As a mathematics teacher and teacher educator, my encounter with fallible nature of mathematics was an eye-opener to think and investigate mathematical practices of our communities. It developed in me a sense of ownership

in the world of mathematics education as a teacher. I started to value local mathematical practices and give examples of our community while teaching mathematics. I believe I started to value practical knowledge (Habermas, 1972) in mathematics classes. In many cases, I provided lots of opportunities to make them responsible and autonomous. The notion of self-refection was used to assess students' strengths and limitations. I tried to create flavor for creating emancipatory knowledge (Habermas, 1972), providing students with multiple authentic tasks and helping them to be responsible in their tasks. While doing do, the uses of mathematical puzzles, games and projects were very helpful.

On the other side, the large part of my mind was covered by the absolutist nature of mathematics. In my experience, many people in the past and still at present do believe in the inflexible view of mathematics. I have been brought up in the similar environment. In many mathematics classrooms, traditional teaching methods are still the dominant forms of instruction. I, as a teacher, demonstrate a procedure showing a few examples, and assign students similar exercises for drill and practice. Students often gain little conceptual understanding of what they are doing. They seem to learn memorizing procedures and trying to match them to similar problems when taking exams because they are shown only the end product and the theorems and algorithms. I am here not arguing from the perspectives that there should be absence of absolutist nature of mathematics. It is needed, and it may remain forever. But, the overemphasis on the absolutist nature of mathematics in schools may not serve our interest (as teacher and teacher educator) to make our students creative with life-affirming skills.

In this context, when I interacted with flexible view of mathematical knowledge, at the beginning, I got confused. Which one should I promote? How can I shift from one perspective to another in both heart and mind? Is it necessary take a

shift? Should I be completely absolutist or fallibilist? The big worry for me was: do they exist in a single basket? Are there any academic discourses that promote both views as I see the existence of both traditions in my context?

At the same time, I refer the intention of my theories, where I advocated as referents rather than framework. I am a practitioner. The main purpose of conducting this study was to improve my practices. So, I was thinking the better spaces where both of the views can be incorporated and I as a teacher can enrich my beliefs about the inclusive nature of mathematics as ever-expanding knowledge system. In this journey, the dialogical nature of mathematics (Ernest, 1994; Luitel, 2013) played a noteworthy role to create an inclusive vision of the nature of mathematics. Ernest (1994) mentioned that, "the dialogical nature encompasses its textual basis, some of its concepts, the origins and nature of proof, and the social processes whereby mathematical knowledge is created, warranted and learnt" (p. 44). The idea of dialogical is very popular in dialogical logic in which various approaches coexist and are comparatively relativistic in their interaction. Taking this notion as a referent, I thought why I don't promote dialogic view about the nature of mathematics in our context where many students come to view mathematics as boring, useless in real life, and increasingly incomprehensible. Steen (2001) writes, "Few can doubt that the tradition of decontextualized mathematics instruction has failed many students who leave high school with neither the numeracy skills nor quantitative confidence required in contemporary society" (p. 5).

The movements for reform in mathematics education are not new, but in recent times the voices seem to have become louder. Where these calls for change coming from are and what are they saying? Burger and Starbird (2005) have pointed out that mathematics contains some of the greatest ideas of humankind but most

students are never exposed to them. Reform is a critical factor in the attitudes that our students will pass on to their children. It seemed that this moment also did not became so much helpful to make students able to ask questions, challenges the status-quo and develop creative and critical skills.

Now, here comes the thorny question: what can be done to really improve the mathematics at the school level? In this context, the discourses created by Luitel on im/pure nature of mathematics in Nepali context were a turning point. He used the label, 'im/pure' to signify an inclusive space for conceiving the co-existence of different forms of mathematics. The distinct category about the nature of mathematics as absolutism and fallibilism do not create spaces to empower us as students and teachers of mathematics. We, as practitioners, should not be divided in "either-or "category of viewing certain phenomenon; such as the nature of mathematics. I think, our purpose should be developing an inclusive image of mathematics with multiple views and forms of mathematics that can enable our students in their present and future life worlds. The present scenario of Nepali mathematics education trapped of elitism and universalism may not be helpful to acquire the creative and critical citizen.

During the course of time, the ideas of inclusive mathematics were enriched by the notion of humanistic mathematics and pedagogy. Many mathematics educators (such as Hersh, 1979; Brown, 2002; Ernest, 2013) raised promising voices for improving mathematics education at all levels through the "humanistic" approach. This approach is not new and variations of it have been used by good teachers since the time of Plato. Humanism as a school in philosophy of mathematics was introduced by Reuben Hersh in about 1979. According to Hersh, a world of ideas of social cultural system which is created by human beings as part of their shared consciousness, and that mathematical reality is neither mental nor physical.

Humanistic mathematics attempts to explore the human side of mathematical thought and to guide students through mathematical ideas by the use of imagery, history, internet and computer tools to discover the beauty of mathematics.

Basically it involves teaching “humanistic content” (White, 1993) (such as; mathematical modeling, soft algorithm, etc.) using “humanistic pedagogy” (Hersh, 1979) in the belief that lack of student motivation is the root cause of the literacy and attitude problems in mathematics education. The movement seeks to return to the educational process the excitement and wonderment of the moments of discovery and creation.

In the recent years, the issues of ethics and values are gaining popularity in the field of mathematics education. Ernest (2013) argued about the overt and covert values of mathematics. In this context, he discussed overt values as those that are explicitly acknowledged by mathematicians. On the other hand, covert values are those that are tacit, hidden or otherwise unacknowledged but which exist and are equally present as important entity in the society. Here, my argument is that we should incorporate both values and ethics to develop inclusive nature of mathematics. Ernest further argued that mathematics is not an ethics-free subject. The ethics of utility and usefulness for human are always there in teaching and learning mathematics, and the beliefs about the nature of mathematics should incorporate the ethical dimension.

In the case of Nepali education system, mathematics is considered a compulsory subject in the school level and a prestigious subject in higher study. NASA report (2008) showed that the average score of the students of grade eight in mathematics is below 50. The enrollment rate in mathematics in higher level is very poor. In the name of standaralized mathematics, there are negligible spaces for

learners and their interest. So, the students perceive mathematics as a foreign subject as experienced by Luitel (2009). The teachers are the classroom leaders who implement the visions of education with the co-operation of various stakeholders in the fields. In this context, I believe that the notion of inclusive nature of mathematics incorporating the humanistic approach perhaps can be one of the best approaches to reshape our beliefs and practices in the area of mathematics teaching and learning.

Chapter Summary

In this chapter, I presented how I developed my beliefs about the nature of mathematics. I came to understand that beliefs are the inherent components and difficult to modify. I, as a teacher and teacher educator, with the adequate experiences as a teacher from primary to university level, have de/constructed series of beliefs about the nature of mathematics, and modified my pedagogical practices accordingly. As I amended my beliefs towards fallible nature of mathematics, I started to modify my pedagogical practices. It shows that a system of beliefs about the nature of mathematics can function to facilitate or hinder mathematical learning, depending on the belief, the object of belief, and the affordances provided by the belief. As a researcher, I am studying my own and contemporary teachers' beliefs related to mathematics teaching and learning, and am still trying to figure out the relations between beliefs and practice determining how teachers' knowledge and beliefs relate to their instruction. There is extensive response that mathematics teachers' beliefs about the nature of mathematics influence the ways in which they teach the subject. So, in this chapter, I attempted to investigate my beliefs towards the nature of mathematics – which could be a foreground in the crucial change and improvement of my praxis as a classroom math teacher and as a teacher educator.

CHAPTER IV

RECONCEPTUALISING THE VISION OF MATHEMATICS CURRICULUM AS MONTAGE FOR INCLUSION

I was eventful with memorizing my past reminiscences about the nature of mathematics and articulating those events in various forms of writing in the previous chapter. My sincere attempt was to unfold my own assumptions and deep-seated beliefs about the nature of mathematics in different periods of my lifetime. I now came to realize to unfold my beliefs and practices on how I have been viewing the (mathematics) curriculum as a teacher and as a teacher educator, and how I took a shift from one notion of curriculum to another. In the context where the curriculum and the textbooks are taken as the ultimate source of knowledge, I think it is very important to assess my (teachers') beliefs on curriculum. More exclusively, I frequently engaged bringing various episodes with examples from the curricula practices of mathematics education of Nepal. Those episodes portrayed the spiraling moments that I have been facing as a student, as a teacher at various levels, as a researcher and as a teacher educator. I often celebrated the events that made me thoughtful within my beliefs about curriculum, denounced my delicate professional practices and made public what questioned my beliefs and practices. In doing so, I envisaged inclusive and transformative vision for mathematics curriculum.

I tried my best to address the second research question in this chapter. The second research question was: *How have I been developing my beliefs towards mathematics curriculum, and how can I develop an inclusive and transformative vision for the mathematics curriculum in Nepali context?*

Curriculum as a Subject Matter: Whose Subject Is It?

It was any day of July, 1998. I was a student of grade 11. It was a very exciting moment for me in many ways. There was no college to offer higher education after my schooling in my village. I left my village for town to continue my study. There was no electricity, bus facility and good shops in my village. Due to the lack of electricity, I was not familiar with the world through the lens of television and internet. There was just a radio set to connect us with the world by the news and other informative programs. My teachers and friends used to consider me as a good student. It was due to my good grades in the tests. The only way I could impress them was by obtaining good grades in the exam. I passed with good grades in the SLC exam and came to the city for further education. The situation in the town was totally different for me. I could watch television, read newspaper, spend time on movies, meet people of different backgrounds and ethnicities, and make choice for my career. I was interested in developing my career in science so that the possibility for medical doctor and engineer remain alive. Unfortunately, I needed to compromise in other areas. Though I was not fascinated to be a student of Education stream in the beginning, I was compelled to join the Education stream due to various reasons.

I was desperate from one aspect being a student of Education. There was no good social image of the Faculty of Education. Many people believed that joining the education stream was the last option because teaching was not taken as a prestigious profession in the society; it is still the same in many societies. In the meantime, I was hopeful due to one of the major subjects I chose. It was mathematics. It was one of my favorite subjects. I was feeling blessed being a college student in a city area from a remote village.

The teacher came to the class. He wrote on the board:

Date: 2nd July

Sub: Foundations of Education

Topic: Curriculum

"Today, I teach you what curriculum is. There are many definitions given by different scholars in this field. I write some of them on the board and you all need to copy them. It is very important for you to know the definitions. You need to memorize them. If you see the past questions of the Board Exam, you can see in almost all the years: what is curriculum? Discuss on the basis of the definitions given by the curriculum theorists." The teacher spoke.

The teacher was very experienced. Our seniors suggested following his notes. The seniors frequently chattered in the canteen and the corridor, "*The board exam questions will not be different from his notes. It is not necessary to read the books. The notes are ultimate*." We were thus very much happy when he provided us with the notes. It was a good opportunity to have such an experienced and demanding teacher.

Perhaps, it was the first time I heard the word "Curriculum" in grade eleven. I memorized lots of definitions provided by the curriculum experts, and maintained notes of important points provided by our experienced teacher. I still remember some of the names, Hilda Taba, Ralf H. Taylor, Saylor and Alexander and so on.

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Taba (1962) argued curriculum as a statement of aims and specific objectives indicating some selection and organization of contents. The focus of Taba was to ascertain the pattern of learning and teaching as the objectives demand them or the

content organization requires them. Almost all the definitions were tilled into the list of the contents to be studied. Yes, I understood. The curriculum is the list of contents which is listed in almost all books at the beginning. The details of contents are provided in the textbooks. The curriculum is a guiding image for the whole book. Of course, the book is designed on the basic of the contents, which is determined at the beginning. This was my initial belief about curriculum. How easy the concept was: curriculum is a list of contents to be studied. I went to my room with a smiling face. I understood the concept in a very easy manner. It made me feel relieved from other classes of pure mathematics, where I rarely understood the meaning, but solved problems and matched the answers at the end of the book.

Next day, I visited the college library. I read some pages of the book – "Curriculum". First few pages were filled with the definitions given by the experts. I sensed what the writer argued. The writer wanted to convince curriculum as the subject matter. I got that whatever subject matter we learned was a curriculum. I thought I understood correctly. I felt that my classroom understating got enriched. My impression of the experienced teacher grew stronger. This was my habit of making confirmation of the lesson that I read in the class. I left library keeping in the mind that - the experienced teacher cannot be wrong. I doubted my own way of confirmation.

After 7/8 years …

I was a student at the Master level. I was lucky I enrolled in New Age University. It was the class of *Curriculum and Evaluation Issues in Mathematics Education.* It was the first day on that course. As it was the second semester in the university, I was aware of the learning environment in the class (See chapter five for the pedagogy of New Age University.) I guessed the faculty would ask us what the

curriculum was. I still remember some of the definitions that I learnt six years back in grade eleven. I was feeling comfortable. I was safe that day. I thought I could respond properly. Unfortunately, the faculty did not ask to write/share the definition of curriculum. He distributed a white sheet of paper and asked us to draw an image of curriculum. I was taken by surprise! Immediately, I observed my friends' facial expressions. I thought they were also feeling the same as I did. Perhaps the faculty noticed us– in a confusing mood. He encouraged us, "When you listen to the word 'curriculum', what comes to your mind? Just try to sketch the image of the idea(s) that come(s) in your mind."Yes, I tried. I started to write. The blank sheet looked something like the image presented alongside.

Our facilitator collected all the sheets of paper. He just had a look, smiled and kept them on the table. He did not respond anything. He distributed a reading material. The title of the paper was "*Portrayal: The Curriculum Field*" written by Schubert (1986).The facilitator divided our class into eight small groups and assigned subtopic to each of the groups. We read the paper, came up with some of our understandings in groups. Oh my god! I was amazed.

How can we take curriculum as an *"Agenda for Social Reconstruction"?* This was the metaphor we were assigned for. We discussed among our group members. The writer mentioned that schools should provide an agenda of knowledge and values that guides students to improve society and the cultural institutions, beliefs, and activities that support it. It is assumed that the society is full of injustices and inequalities. The nature of injustices and inequalities may change, but it remains

forever. The goal of education is to aware students of such societies; encourage for raising voices for oppressed people and ultimately contribute for changing the society.

Should education advocate for the social justices? Is it possible? How can a teacher arrange discussions on some social structures as wrong and some aright? How can we argue to reconstruct societies? Can we advocate against the assumptions, cultures, rules and regulations of our society and governments? Isn't it a job of politics?

This idea challenged our understandings. We were confused. We guessed that our facilitator would later ask us to share. But what would we share?

"We are not convinced ourselves. How can we make others convinced?" One of the group members said.

All of our friends seemed busy with our own job, conceptualizing the metaphors from the assigned reading material. Almost of us seemed engaged with our assigned tasks with fear and excitement. A part of my mind was busy in recalling the image, *curriculum as the list of contents*, the one and the only one belief. On the one side, I was taking the idea of curriculum as a list of contents as truism, and this was what I had understood for the last many years. On the other side, the reading material was challenging my deep-seated beliefs about curriculum. Although my strong beliefs were with curriculum as a list of subject matter, some of the queries came to my mind. What were these subject matters? What were their focuses? How were the subject matters determined to be learnt? Who would determine the subject matter? What was the process of determining the contents? What were the influencing forces for the selection of subject matter? In the case of mathematics, why were we learning the same mathematics for many years? What were the uses of abstract mathematical

knowledge in our school level? Many teachers, including me, were not satisfied with the contents that were being delivered for many years. But, why did changes not take place? Whose interests were being served?

The facilitator grabbed our attention by requesting us to stop the discussion and to be ready to share. Our group was ready although we did not agree with the idea that the curriculum should act for social reconstruction. It seemed that all of us were ready in groups. The first group started sharing on curriculum as content or subject matter. We agreed with that idea. Yes! It was correct. We had been teaching various subjects to strengthen our mental ability fostering intellectual aptitude. As I believed that the purpose of education was to make knowledgeable persons for which the deeper understanding of contents was very much essential. When the second, third and fourth group shared different metaphors *curriculum as a program of planned activities, curriculum as intended learning outcomes and curriculum as cultural reproduction* respectively, it seemed that we all agreed with those ideas. There were no many questions for those groups. After sharing those previously stated metaphors, I made sense that these all metaphors (*curriculum as a program of planned activities, curriculum as intended learning outcomes and curriculum as cultural reproduction*) did exist in a thread of the priori designed contents to be delivered. The contents were necessary along with planned activities to achieve the intended learning outcomes (i.e. cultural practices.) These ideas supported each other. They complemented each other.

The turn went to the fifth group. For the fifth group, the metaphor was *curriculum as experience*. The group members shared their reflections on the assigned metaphor. According to the assigned idea, the means (process) and ends (outcomes) were inseparable. They came together and contributed each other within the continuum of means-ends as advocated by Dewey (1892).The experience was taken

as an integral part of both process and outcomes in educational practices. One of the students asked, “How can we measure experiences of a person? How do we know s/he has experienced?” The group members tried to escape from the question with airy-fairy responses. It seemed that the group members could not convince others about how experiences could be measured. In what ways can we guarantee that the students have experienced? Isn’t it personal? Today, when I look back to those queries, perhaps, we were trying to measure the essence of experiences more quantitatively. We were searching the objective tools so that we could declare who were experienced. In the meantime, the facilitator said, “*I will respond to this question. Let us listen to other groups’ reflection*”. The discussion was over without addressing the queries of the student. Perhaps, all of us were expecting the responses from the facilitator.

Now, the turn went to the next group. The metaphor was *curriculum as currere*. This was not a new word for me. I guessed it was not new to almost all of our friends as most of us had grown up in the same academic environment. In my understating, *currere* referred to running the race in the ground. The ground was compared as the curriculum, taking part in the race was the learning process, students were players and reaching to the destination was achieving the goal of education. One of the group members shared such understanding in the metaphor curriculum as currere. He mentioned that curriculum had toemphasize the individual's own capacity to reconceptualize his or her autobiography. The facilitator further explained. The curriculum should move historically into his or her own past to recover and reconstitute origins, and imagine and create possible directions of his or her own

future. I immediately asked question to the presenter. "*You are sharing that curriculum should foster personal development analyzing their past and envisaging their possible future prospects. Every individual is different. The purpose of each individual may be different in learning. In such case, is it possible to materialize such curriculum? If it is possible, how can we make such curriculum to address individual needs and interest in case of school mathematics?"*

The presenter looked perplexed. He looked to the facilitator and inspected his mood. The facilitator said, "Can you defend your idea?"It seemed that our friend took

reference of William Pinar (2004). In regard to the metaphor, curriculum as currere, Pinar (2004) argued, "it provides a strategy for students of curriculum to study the relations between academic knowledge and life history in the interest of self-understanding and social reconstruction" (p. 35). So, I thought …. it (curriculum as currere) was possible! Perhaps the facilitator was not satisfied with his explanation. He said, "It's okay. I address this question later."

Then, it was our turn. My friends from our group requested me to share our reflection. I went to the front. "I am not convinced with the notion of the metaphor *curriculum as an agenda for social reconstruction*. But, I try to convince you." I began with some excuses and confidence. All of us laughed. I further explained, "This metaphor assumes that no culture or society is perfect. So the purpose of education is to build better society through cultural reconstruction. But our group do not agree with this idea. We think this is largely the job of politics rather than educational institutions."

In the same way, rest of the members shared their understating on different metaphors. The discussion was engaging. Most of us actively participated. "*Thanks for your sharing. We are running out of time. We continue this discussion in the next class*". The facilitator ended the class.

Curriculum: Fostering Intellectuality or/and Creatively

As I elaborated before, I encountered the word "Curriculum" for the first time when I was a student of higher secondary level. This view of curriculum (as expressed above) is known as the traditional and widely accepted view; some also say it as antiquity, conceptual-empiricist view as mentioned by Pinar (1978; 2004). I now present a narrative focusing my struggles reshaping my beliefs on curriculum beyond the content or subject matter and with a well-known professor who still advocates curriculum as contents to be delivered.

It could be any day of March, 2008. I was a teacher of a reputed school in the Kathmandu Valley –*Swimming Pool School.* Working in a reputed school, I sometimes would get opportunity to participate in a national seminar related to teaching and learning issues. At the same time, I was a master level student at New Age University. I frequently would get opportunity to listen to the national and international scholars as guest lecturers. The school where I worked selected me to participate in a seminar *Curriculum Issues in Nepal*. In the name list of the presenters, there were some professors with doctorate degree. One of the professors was very popular in public media. He frequently would appear on TV set and print media with his thoughts. *Thanks god! My school selected me for this important event. I hope it is a good opportunity to listen to such great personality*. I went to the seminar with lots of excitement. The participants were school level teachers. The master of ceremony began the program focusing the purpose of the program and the introduction of the

resource persons. The master of ceremony said, "*Dear Professor Command, please deliver your valuable lecture on curriculum, its focuses and how we can make its best use*". Everybody gave a big round of applause. Professor Command came to the podium and began his lecture.

Dear friends and teachers,

It is my pleasure to share my ideas about curriculum. The word 'curriculum' came from the Latin word "currere" which means a run way. So, the curriculum is the runway of the educational plan. The curriculum is the framework of what should be taught. It contains the list of subject matter to be delivered inside the class.

Now, I am going to share some of my understating regarding the subject matter. The subject matters are very important trajectories that permit students to be master in certain knowledge. There are much important and useful subject matter in the world. The new knowledge is being explored in the world day by day and they have created their own space in the society. In this regard, the aim of education is to make people aware of the subject matter, make people knowledgeable by providing in-depth information about the subject matter. The important and useful knowledge should be kept inside certain subject discipline wise. For example, the mathematical knowledge should be kept inside the subject "mathematics", the knowledge of social norms and values should be kept inside the subject "Social Studies". This is the most traditional and widely used view of curriculum.

In the past, curriculum used to have "seven liberal arts" as subjects divided into trivium and quadrivium. The trivium consisted of grammar, rhetoric and dialectics, whereas the quadrivium consisted of arithmetic, geometry, astronomy and music. It was considered that seven liberal arts were important subjects that gave sufficient knowledge to the children that were necessary during their lifetime. For

this, we needed to teach the great ideas taken from great books written by history's finest thinkers and writers.

The aim of curriculum is to make people intellectual. We need to cultivate the mental ability of our students. If we teach the facts and principles to the students, they can cope with the society. We need to fix the intended learning outcomes at the beginning. The teaching learning strategies should run after the intended learning outcomes. As I am from mathematics background, I believe in practice. I suggest to you to keep this statement in your mind. "*Practice Makes a Man Perfect*". In other subjects, I believe in memorization. If the students do not memorize the facts and figures, how can they appear in the examination? As we all know that there is high competition in the market, we must prepare our kids with lots of knowledge. If our students do not secure distinction in the national examinations such as SLC and HSEB, they cannot compete in the medical and engineering entrances. Most of the parents want their children to be doctors and engineers. We are here to fulfill their desires. I am happy to know that your schools have been managing extra classes from the beginning of the session. The students come to the class in the early morning and spend the whole day reading and writing. The old proverb is popular among us, "*dhawanti kheti ghokanti vidhaya*" (literally: Crops by tendering; knowledge by memorizing). This is the way to get success. The curriculum also should focus on how to make students knowledgeable.

I wish all the success for you and your school. I cannot be here more time in this program and I am sorry I cannot listen to your queries now as I need to go to the Ministry of Education (MOE) to discuss the issues of present school curriculum. But, I can give you my e-mail ID. You can mail me if you have any queries regarding my school curriculum.

The lecture was over.

He asked a marker from one of the members of the organizing committee and wrote his e-mail ID on the whiteboard. The whiteboard was near the podium. I copied his e-mail ID. The black car was ready on the ground. He got into the car and left the venue. Then, it was time for the next curriculum specialist.

Interestingly, it was just a month after I learnt various metaphors of curriculum in my master's classes. I was not satisfied with the lecture of Prof. Command, who emphasized curriculum as subject matter. I knew he was one of the most influential and one of the senior professors of the Classical Academic University[3]. I could not think that he was unaware of various dimensions of curriculum, and with the latest discourses in the discipline of curriculum. It might be that he was addressing the need of the participants believing that most of the school level teachers do not have enough knowledge about curriculum and its practices. My mind was busy thinking about why Prof. Command spoke for the one notion of curriculum, which was by then regarded as the disempowering notion of curriculum among Nepali teachers, as discussed by Luitel and Taylor (2005). I could not pay attention to other lectures of that day. I was mentally disturbed. It might be the case of being thoughtful. The program was over. The first lecture was still striking in my mind. *Oh! I have the email ID of Prof. Command. I will write an email with my thoughts on curriculum. Let's see how he responds*. I began to compose an e-mail expecting his responses.

The content of the e-mail was like this.

To: prof.command@gmail.com

Dear Prof. Command

Namaste

[3] This is a pseudoname used for the university where I studied my undergraduate level. It is the oldest university in Nepal.

It was a good opportunity to listen to your speech this morning. I am from the *Swimming Pool School.* Perhaps, you know our *Swimming Pool,* which one of the biggest schools in the nation. After listening to your lecture today in the seminar, many questions emerged in my mind. I am also doing master in New Age University. At that university, I got ample opportunity to discuss various dimensions of curriculum in general and mathematics education in particular. But, unfortunately, I could not get any thoughts on other than curriculum as list of contents in your lecture. So, I am curious to know how you have developed the notion of curriculum. I do hope that you do not get me negatively, and will respond my queries positively.

Dear Sir, I was so happy when I heard that you began your lecture with *curriculum as currere.* But, the notion of currere you described was completely different from my understandings of it. For me, currere is not only a place for running a race. According to Pinar (2004), "currere invites the interpretation of educational experience, scrutinizing manifest and latent meanings, conscious and unconscious content of language, as well as the political subtext of such reflection and interpretation" (p. 58). I think it is more personal and political rather than a common ground for race. I want to listen further from your side regarding this construct.

On the other side, my worry was on your over-emphasis on curriculum as subject matter. From your lecture, I came to understand that the subject matter, for you, is the perennial knowledge and the information. Now, I want to share with you the notion of culturally contextualized curriculum. For me, our curriculum including the curriculum of mathematics should also cultivate the local knowledge as the subject matter without neglecting the roles of universal knowledge. I think you agree with me on the view that the notion of universalization has become a new form of hegemony in the era of neo-colonization in many of the non-western countries. Luitel

and Taylor (2005) mentioned that, the primary notion of contextualisation of mathematics curriculum is to ensure the inclusion of local knowledge traditions as the curriculum content." (p. 11). As we all know that Nepal is a multicultural society and it is prime time to investigate and preserve our social assets though education. I do not think that we are much behind in this issue. KUSOED and UNESCO (2008) conducted a research study to enable lower secondary school teachers to develop culturally contextualised curriculum resource materials to supplement the existing lower secondary mathematics curriculum. I think it is time to encourage such scholarly task, and advocate among many stakeholders by the people like you. In this context, I have a question to you, cannot we incorporate culturally contextualized (mathematics) curriculum in our school level?

Second, you mentioned that the aim of curriculum is to make people intellectual with the cultivation of students' mental ability. Yes, I do agree on this view. At the same time, I think the purpose of curriculum as to make students intellectual is necessary, but not sufficient. How do students cultivate their critical, creativity and imaginative skills if we just encourage them to memorize contents? In this regard, Fraser and Bosanquet (2006) stated that, "the curriculum develops through the dynamic relationship between action and reflection, in which the process of critically reflective practice is incorporated into the process of curriculum development" (p. 281). In the era of twenty first century, where millions of tidbits of information are being added within few hours, I think, the purpose of school curriculum should be able to foster creativity, and to develop students towards real-life problem solving skills. Lalingkar, Ramnathan, and Ramani (2015) also stated that the Indian National Curriculum Framework has as one of its objectives the development of mathematical thinking and problem solving ability. My argument

here is to advocate the aim of curriculum as to make students creative citizenry. What do you think about this idea?

The next thing you mentioned in your lecture was *Practice Makes Men Perfect*. I did not get it properly on the notion of practice you were intended. I think the sense of this famous metaphorical expression has promoted the view of behaviorism with the belief of existence of stimulus-response in the classroom. Do you think that this sort of curriculum would help our kids to survive in this age? What about the curriculum that envisages the critical pedagogy inside the classroom? In this regard, Tutak , Bondy, and Adams (2011)argued that we need more curriculum materials that do not treat teachers as robots to mindlessly implement pedagogy. You might have heard about school-based (and teacher made) curriculum. I heard that teachers themselves prepare curriculum in Finland, and the education of Finland is taken as one of the most successful systems in the world. What are your thoughts regarding school-based curriculum in Nepali society?

Dear Professor, I am writing this email to you assuming that I will be benefited with your reply. I think I am a passionate teacher, and I am very much interested to contribute to the field of mathematics curriculum with some constructive and creative endeavor.

I am waiting for your responses on my views.

Best Wishes

Binod

I Do Not Know Curriculum; I Know Textbooks

It could be any day in September, 2010. I was somewhat more confident than before. It was the second time I was presenting myself as a teacher trainer in front of school level mathematics teachers. The organizing committee was PABSON and one

of the text books publishing houses. Due to not having enough experiences as a trainer, I was also feeling a bit hesitant. I think I could present myself with high moral in front of my students, but felt a bit difficult in front of teachers. They were teaching in the same level where I used to teach. The only difference between me and the participants was that I had the experience of a textbook writer and also had university degree from a reputed university in education field, but many of them did not have such. I was called onto the podium with my some exaggerated introduction by the organizer. He told, *we have a young, dynamic and energetic teacher trainer. We have great hope from him in future in the educational field. Now, I would like to welcome Mr. Pant to deliver his training package "Mathematics Curriculum in Nepal".*

The floor was open to me. I was prepared with PowerPoint slides. My plan was to make participants engage in discussion about the Nepali curriculum, and its strengths and limitations. I was hoping to listen to some critical comments on mathematics curriculum of Nepal from the participants. All the participants were silent. I broke the ice with the questions; *how many of you have gone through our school curriculum?* Four-five hands were raised out of about 35 participants. Further, I threw the question, *how many of you have read the mathematics curriculum?* The whole mass turned into silence. There were no any hands raised. After a moment, one of the female participants, who was sitting on the front row, told,

"I have heard about curriculum. I completed Intermediate Level in Education. At that time, I studied about curriculum. I think it is the collection of all the documents that should be taught in a whole academic session. I am not sure what exactly it is. I heard this much only about curriculum."

When she completed her sharing, I was about to respond to her. But, another participant immediately overtook me.

"I fully depend on the textbook." I follow the problems given in the textbooks. I hope they are guided by curriculum. The textbook writer might know better about curriculum. I do not have time to see this and that. I do not have any leisure time in school. I think many of us as a mathematics teacher teach more than 10 hours per day including private tuitions." He shared with his constraints. It seemed that majority of the participants were accepting his thoughts with nonverbal responses. I also respected his voice. It was more or less convincing to me. When I was a school level teacher, I was also engaged in more than 12 hours lectures per day.

My purpose of the session was to raise some critical consciousness about school mathematics curriculum, and encourage them to envisage better school mathematics curriculum. For this, I was expecting such participants, who had some pre-requisite knowledge about curriculum so that I could go beyond the narrowly conceived notion of school curriculum *as a collection of subject matter*. But the situation did not allow me as I planned. Most of teachers were considering textbook as curriculum. I immediately revised my plan. I thought this was a precise moment to challenge participants' deep-seated myths with some hands-on activities. I divided the participants in some groups. I took out the curriculum prescribed by Curriculum Development Centre (CDC) from my bag and asked the members of the organizing committee to make some copies of it. I requested to bring some textbooks and reference books from the library published by different publishing houses. I distributed a copy of curriculum and a textbook to each group. I told them to go with

specific goals of the curriculum and the textbooks. Each group was assigned to match the curriculum of different grades with the textbooks. Here, I was not taking the curriculum developed by CDC as an ideal document. I was aware of various issues raised in the curriculum itself - whether the mathematics curriculum was capable of expanding mathematical literacy to higher mathematical knowledge. Here, my intention was to make participants thoughtful on how the textbooks were developed from the eyes of the prescribed/developed curriculum so that they can make holistic sense of the curriculum and the textbook. The participants spent about half an hour with the textbook and the curriculum. I frequently supported them addressing their quires in their group work.

After having the discussion and noting down their (important) concerns by each group, one representative from each group shared the common views. One of the group members – Ramesh - came to the front. This group was assigned for the grade one curriculum.

Ramesh told, "*We found many differences between the curriculum and the contents presented in the textbooks. The curriculum prescribes to teach numerals up to 100in grade one. But this textbook aims to teach numerals up to 500. The curriculum strictly mentions that the addition of two-digit number without carry over should be taught in grade one. But this textbook aims for addition of three-digit number with carry over problems. Our group came to realize that textbooks writers are making mathematics difficult. They have imposed the contents to the students. So, the students find mathematics difficult. We worry about the role of government in this regard. Why Ministry of Education (MOE) is not addressing this issue? Many of the teachers are blindly following textbooks as an ultimate resource as we are doing. I think over trust in the textbooks may be problematic for us.*

He went back to his seat.

Now, the turn was of the second group. Intentionally, I had assigned them to assess the teaching and learning approaches mentioned in the curriculum, and to discuss how they practiced in their classroom.

One of the ladies representing the second group came to the font to share her group's discussion. She said, "*We wondered when we saw the present primary level curriculum of mathematics (2063 BS). The teaching methods suggested in the curriculum are appealing to us. Those methods are: demonstration method, question-answer, induction, concrete to abstract, simple to complex, mathematical induction. The curriculum has also suggested to use teaching materials (manipulatives and solid objects) while teaching mathematics in the primary level. Almost all of us were unfamiliar with such strategies. But we do not know what they mean."*

In this way, the entire groups shared their understandings on the assigned tasks. This event made participants aware about the present curriculum, which is, I think, a bit progressive as it was conceived as *lecture-based contents* by many novice teachers. Though I was planning to help them to develop an agency of critical perspectives to view the mathematics curriculum, I could not succeed. May be, I needed to wait a few more years for this.

I Give You Formula! Do Not Talk About Curriculum!

It was a day in January 2009. I was working in an airy-fairy private school as a secondary level mathematics teacher. I was about to quit the school and planning to join a so-called big schools in terms of the number of the students. But the School Principal made me promise to manage one capable teacher before I left the school. I agreed for the task as he requested. It was totally a new experience for me. I was

feeling uneasy to observe the class of the prospective candidates of the teachers. Anyway, I had to do it.

One of the candidates entered into the classroom with some colorful markers and a duster. He knew that he was being observed and evaluated. The school principal informed me that it was his second day in the school. After a few minutes he entered the classroom, I knocked at the door. I entered the classroom without waiting his non/verbal approval. Perhaps, he wanted to impress me. He acted as if he had just entered the classroom.

Teacher: *Good morning Students*!

Students: *Good morning, sir!*

Teacher: *Good morning! Good morning! Sit down. Yesterday, I gave you lots of formulas from trigonometry. I told you to memorize them. Did you memorize them?*

Nobody spoke. There was a pin-drop silence in the class.

He further asked. *"Who is the first boy in the class"?* One of the boys stood and told (first boy), *"Sir, I also could not memorize the formulae but I solved all the problems of the exercise by using the formula you have provided."*

Teacher: *Formula is formula. You must memorize them. Otherwise, how can you face the exam? Nobody will provide you the list of formulae. There are several formulas to list out in trigonometry.*

One the students with her fluent English raised a question. *"Sir, I came from Singapore. In Singapore, we should not memorize the formulas. We get a list of formulas. We should apply them while solving the problems. Remembrance of the formula in Singapore is considered a waste of time and effort. Doesn't our curriculum here in Nepal offer list of formula at the time of examination, sir?*[4]

[4] In Singapore, the students are habituated to use the word curriculum than the textbooks.

Teacher: *Miss Rai, this is not Singapore. This is Nepal. We have been following the same approaches for many years. I became a teacher with this system. Now, I am teaching in the same ways as I was taught by my teachers. I do not care what curriculum says. In mathematics, we must solve problems.*

He listed out the formulas on the board. According to him, it was the continuation of yesterday's class. When the students copied all the scripts from the board accepting them as the god-made facts, the teacher selected one problem from the textbook and solved in a very systematic manner: writing; solution, by the formula, either-or, hence proved, etc. It was seen that he was proving himself as a good algorithmic problem-solver. The class was over. My assigned job was over. I left the class. After a few minutes, the mathematics teacher also came out of the classroom. We together went to the office room. On the way, he told, "*sir, how was my class?* I responded to him normally, *"It was okay"*.

The principal was in the room. He told the mathematics teacher to wait in the teachers' room. The principal took me in the canteen. He ordered two cups of coffee. We sat in the chair. "*Binod Sir, how was his class? Can he solve mathematical problems? I have seen his mark sheets. He got distinction marks in his master level. I think he is very talented. What do you think? Did he take the class in his control? Does he seem like mathematics and science teacher*? *You know how a good mathematics teacher looks like?"* The principal asked me. His notion of mathematics teacher was very strict.

I gave a mild smile. He observed my face and doubtfully asked me, "*Did not he teach effectively in the class?"*

I was not satisfied with the class he delivered. The way he was showing himself as a lone sovereign inside the classroom discouraged me to provide good

comments in his teaching. I was not feeling comfortable to express my observation. But, I was compelled to do so because I was assigned for that. I was recalling Miss Rai's questions and teacher's responses on her question. I told the Principal, "*It is okay but I prefer teachers having pedagogical background. It seems that he can solve mathematical problems but he is meager to make students solve mathematical problems. He has understood that mathematical knowledge as taken for granted. He should have proven or verified how the formulas have been introduced. I think he is not aware about mathematics curriculum. As a teacher, one should be familiar with the curriculum at least of Nepal."*

"*Hmm…I think he should teach mathematics rather than being familiar with the curriculum. Am I wrong, Binod Sir?"* The principal in/directly expressed his interest.

I thought I could not convince the School Principal. I know that the Principal was neither from mathematics background nor was he having a formal degree in Education. The mathematics teacher our Principal was searching should hold an excellent academic degree and have the capacity of classroom control. I thought I cannot make him understand what I intended to tell. Therefore, I advised the Principal, "*I think he can do better than this in the coming days.*" My mobile rang I received the call. I told the principal that I had to leave then. I left school and went to my room and recalled some moments of the class in which the novice mathematics teacher taught. His ignorance towards curriculum was really discouraging me as one of the members of education sectors. Why did he say so; "*I do not care what curriculum says. In mathematics, you must solve problems*." Why did the prospective teacher say that *Miss Rai, this is not Singapore. This is Nepal. We have been following the same approaches for many years.* What did it mean, "*This is not Singapore. This*

is Nepal". Perhaps, he was trying to figure out Nepal as the country where whatever things a teacher wanted could be done.

On the other hand, the School Principal's belief towards curriculum was also not so empowering. He was not giving much priority to the curriculum as an important material to be familiar with by the school teachers. I think this particular narrative of my professional experience may show a picture of how school teachers and principal have taken curriculum.

Dear Sir, Can We Develop Our Own Curriculum?

I was teaching one of the courses *Curriculum and Evaluation Issues in Mathematics* for the students of M Ed second semester. It was my second year since I started teaching as a full time faculty in the department of Mathematics Education. It could be any day of June, 2014. I felt fortunate as a full time faculty in this department as I was a student of the same program and I joined in this institution before 5 years as a part time faculty. The students were not new for me, neither was the course. One day, I was making arguments on Culturally Contextualized Mathematics Curriculum. I began the class in this way.

Dear Friends, Good Afternoon!

We discussed curriculum metaphors; historical, social and psychological foundations of curriculum; curriculum as process versus curriculum as product in the previous classes. Now, we will discuss *Culturally Contextualized Mathematics Curriculum*. Perhaps, this is a new idea for you. This is a gateway for developing inclusive and transformative vision of mathematics curriculum. We are rich in cultural practices. Un/knowingly, we have been using mathematical ideas in our day-to-day work. Many of us are brought-up with the view mathematics as an "important" subject from the early grade. If you ask me today, what does important mean in this

case? May be, I will be unanswerable. Let us be focused on one issue today. How do you take our cultural activities and school mathematics? Are those school-mathematics culture-sensitive? Do we perpetuate multicultural worldviews in Mathematics Classroom? How can cultural practice be embedded in our maths curricula? There are the issues to be discussed today!

Except for a few normal questioners, all my students were mute followers in the first semester. They all were from Classical Academic University where many students would not get an opportunity to interact with faculties with the critical questions. We, in our New Age University, frequently encourage students to ask nonconformist questions and contribute to the discussion. In the first semester, whenever I entered the class, I felt like being the solo sovereign of this place. But in the second semester, my students started to challenge me with logical arguments as I expected. One of the frequent questioners, named Bibek asked, "*Sir, there are more than ninety ethnic communities in our country. Each community has their own practices. They are*

I Can Do Nothing! I Can Do Everything!

Government determines objectives
Experts assemble curricula
Writers produce textbooks
Head teachers declare "the textbook"
Trainers prescribe teaching methods
Department head evaluates students' achievement
I go to the classroom
I try to teach mathematics
But, I can do nothing!

***

I give meanings to the objectives
I can develop my own curriculum
I prepare contextual mathematical problems
I have choices among many teaching methods
I can see mathematics around us
I help students to learn mathematics
I continually assess students' performance
So, I can do everything!

rich in their culture. Do you mean that we can make different curriculum for contextualization with their culture? I think it is not practical. On the other hand, this is an era of globalization. We need to prepare our children for the world, not only for the particular community and the nation. If we restrict our kids within their cultural context, where do they stand in this competitive world?" When you were sharing the background of today's class at the beginning, I am thinking how it can be materialized. More than that, we all are mathematics teacher. And, largely mathematics is taken as a universal language. In this context, what is the usefulness of culturally contextualized mathematics curriculum?

Without giving me any time to respond to him, another lady, who has recently started to teach mathematics for lower secondary level, threw a question; "*sir, I did not get what you were mentioning as inclusive and transformative vision of mathematics curriculum? I heard these words from the mouths of political leaders only. How do they appear here?"*

As I was searching for possible responses to his difficult questions, another student (who was interested on Ethnomathematics, and have been engaging in various papers on cultural nature of mathematics) overtook me with a couple of counter questions to Bibek. "*Bibek, why do you raise such questions? I think the incorporation of local cultural practices does not mean to discard the global perspectives. The balance of both perspectives is needed, I guess*."Without giving any chance to Bibek to respond to these questions another student threw yet another salvo at him: "*Don't you know that we are entering into decentralized political system to empower local people with their local assets. If we see from negative angle, we cannot do anything. But, if we see with lots of hope realizing our responsibility, many things can be done."*

I replied, "*Bibek, thank you for the questions you raised. I want to thank other friends who contributed in this discussion. The ideas of culturally contextualized mathematics curriculum are really a challenging job to make sense of and more challenging to practice. More than that, the inclusive and transformative view of the curriculum is really an important construct, and it is time to promote this view in our Nepali context."*

I presented various narratives of myself as a student of mathematics education and as a teacher educator in different points of time. While doing so, I attempted to present the teachers' beliefs about the mathematics curriculum. Almost all the above narratives presented the narrowly conceived views of curriculum. The moments I spent in New Age University as a student of Master/M Phil level and the various opportunities I received to interact with national and international curriculum experts forced me to examine the present mathematics curriculum of Nepal, and it encouraged me to envisage the possibilities of incorporating inclusive and transformative views of mathematics curriculum.

Now, I want to discuss the possibilities of inclusive and transformative vision of mathematics curriculum. Regarding the inclusive philosophy in education, Quicke (2008) mentioned that, "….it requires us to see the pupil and the teacher as agents, that is, as persons who can become independent, active and powerful through interacting with others in a social context to produce a community where everyone is a participant and everyone is empowered." (p. 15). The agenda of inclusion is getting stronger in the field of education in general, and in the field of mathematics education in particular. Here, I have understood the notion of inclusion not only in terms of all students' active participation in leaning but also incorporating the multi perspectives of viewing mathematics and teaching and learning. Regarding the inclusiveness in

mathematics classes, Sullivan (2015) argued that, "the implication is that learning mathematics can create opportunities and that the opportunities should be made available to the greatest number of students" (p. 122). Elsewhere in my narratives, I have raised the issues of participation of a very few students in mathematics classes, and their monopoly in all mathematical activities. More than that, the deep rooted beliefs towards negative images and myths of mathematics (and mathematicians) among the public (Sam, 1999) have become a great hegemony for the so-called "weak students" disempowering them in mathematical activities.

One of the issues for making mathematics curriculum inclusive is discussed in terms of access. In this regard, Cennamo, Ross, and Ertmer (2010) argued that the integration of technology provides a better access of mathematics to the students with equity and inclusiveness. From my experiences of using technology in mathematics classroom, I also came to believe that technological tools can be potentially used to make mathematics more dynamic through multiple representational systems, a basis for creating useful, adaptive and meaningful mathematical learning enterprise. Belbase (2015) also argued that the "*integral belief*" about the nature of mathematics incorporates technology-embedded curriculum, does not help only for making mathematical concepts and ideas more visible, but also helps students for socialization, by engaging in meaningful discussion while using technology. In recent years, the uses of technology in almost all sectors have exponentially increased in our society and professional activities. It seems that many students are fond of using technology at home. At this context, incorporating technology in Nepali mathematics curriculum may encourage many students towards mathematics, and possibly it may contribute to making positive images about the mathematics. Drijvers, Doorman and Boon (2010) discussed how we can incorporate technology in mathematics

curriculum and make the classroom as instrumental orchestrations for making technology-rich mathematics classroom. Here, the authors argued the combination of various technologies as the instrumental orchestrations.

In the context of Nepali mathematics curriculum, Luitel and Taylor (2009) argued for inclusive curriculum space with the metaphor *curriculum as montage*, where the authors have explicitly discussed that antagonistic images of mathematics also can/should co-exist, particularly the prevailing image of mathematics as a body of pure knowledge and the counter-hegemonic image of mathematics as cultural activity. Although it is a very challenging task to see the present mathematics curriculum from the lens of inclusion, I think, it is not impossible. The debate of incorporating the local and cultural practices in mathematics education has been getting louder in the recent years. The issue of inclusion is at the centre in the national discourses too. Many teacher educators and researchers in the university (Luitel, 2013; D' Ambrosio, 2015) advocated the cultural nature of mathematics for inclusive mathematics curriculum. In this context, the historical representation in International Conference in Mathematics Education (ICME-12) from Nepal also argued the necessity of inclusive mathematics education in Nepal, and it can be done with the view of culturally contextualized mathematics education. In this conference, Luitel et al., 2012) mentioned that developing a transforming vision for a culturally contextualized mathematics education that is meaning centred, life affirming, and inclusive of mathematical practices arising from local cultures should be the focus of school mathematics.

Another view to be promoted in Nepali context is *transformative vision of mathematics curriculum.* In terms of transformative vision of mathematics and science curriculum, Taylor (2015) argued that the traditional view of curriculum that

argues on *what and how* is not sufficient to empower students as future citizens. He emphasized that transformative vision of school curriculum embraces humanistic perspective in which the issues such as *why this curriculum* and who are the students and teachers who practice this curriculum get enough care from the perspectives of emancipating the learners. Slattery (2006), in the seminal book, *Curriculum Development in the Post Modern Era*, argued from the transformative view of the curriculum development focusing on ecological sustainability and holistic models of teaching as a primary focus of the postmodern curriculum. For this, the school mathematics curriculum should enable learners for understanding human action through multiple sensibilities (such as metaphoric, poetic, dialectics).

One of the approaches to foster transformative vision of mathematics curriculum could be the uses of *currere* and autobiographical approaches to curriculum development. In this approach, the students are treated as individuals and their growth (physical, psychological, emotional, metal, critical, etc.) is always taken as the central part of the curriculum. Pinar (2004) discussed that *currere* seeks to understand the contribution academic studies make to one's understanding of his or her life (and vice versa), and how both are implying in society, politics, and culture. In the case of having more traditional view about mathematics curriculum, the autobiographic approach could be one of the alternatives to promote transformative vision of mathematics curriculum.

In the transformative vision of mathematics curriculum, the students are expected to be autonomous and responsible. According to Grundy (1987), autonomy and responsibility are the two pillars of emancipatory interest. He mentioned that the end result of an emancipatory interest is 'a transformation of consciousness in the way one perceives and acts in the world. I am here arguing that the school mathematics

curriculum should be developed form the perspectives of Habermasian emancipatory interest in which the teachers and students have spaces to challenge the taken-for-granted assumption about mathematics and mathematics teaching, and students and teachers can act as change agents, realizing the sense of autonomy and responsibility to oneself and the society. I think this is one of the important tasks in the field of (mathematics) education envisaged by the multi-paradigmatic research design that I employed in this study.

Chapter Summary

In this chapter, I attempted to unfold my beliefs and practices of curriculum in general and of mathematics education in particular. I engaged re/presenting my stories as a student, teacher and teacher educator. While doing so, I tried to capture various episodes to express various notions of mathematics curriculum. I brought the voices of students and teachers to develop rich discussion of how they view mathematics curriculum. At last, I emphasized the importance of culturally contextualized mathematics curriculum, technology-rich curriculum, curriculum as currere, emancipatory interest driven curriculum to promote the view of inclusive and transformative mathematics curriculum.

CHAPTER V

JOURNEYING INTO MATHEMATICS PEDAGOGY AS POLITICAL ACT

I have solved many mathematical problems till date - countless problems inside the classroom and a few outside. I spent significant time convincing my students that mathematics teaching is about doing mathematical problems to get the correct answers. Later, I slowly took a shift from doing mathematics to teaching mathematics with lots of tricks, tips and techniques, spent many years to learn better techniques to become a 'successful' teacher producing better results. Later on, I started engaging myself as a math learner and seeking the significance of the methods I employed to teach mathematical concepts, relations, and logics. I am now on the way of searching better alternatives that help students learn mathematics in a meaningful way.

In this chapter, I bring various narratives of my professional career as a teacher and as a teacher educator illuminating the path of my pedagogical practices in the past, at present, and also try to envision for the future. While doing so, I attempted to address the third research question: *how have I been developing my beliefs towards the pedagogical practices, dominant in the field of mathematics education in Nepal, and how can my notion of pedagogy as a "political act" be helpful as a good alternate pedagogy for Nepali society?*

This chapter includes six sections; Memorize Them! Prove Yourself "Genius", I Can Solve Mathematical Problems! I Am a Good Mathematics Teacher!, Let's Request Mr. Tips for Tuition Classes!, Sir, Leave the Score! How is She in

Mathematics? Please Sir, Give Us the Best Techniques of Teaching, Envisioning My Mathematics Teaching as a Political Act

Memorize Them! Prove Yourself "Genius"

When I was a student at the secondary level, there was an option to choose between mathematics and history as an optional subject. I was hearing horrible myths about studying additional mathematics. It was that only talented students could take mathematics as an optional subject. Many of us were interested in additional mathematics, but we needed to prove that we were talented.

It was a day of February 1997, the first day in grade nine. We all were in happy mood. A dark and tall teacher entered the classroom. He said, "*I am a teacher of additional mathematics. It is a very difficult subject. I came to know that many of you are interested in taking mathematics for an optional subject. There are many formulas. You need to memorize them all. If you are able to reproduce them tomorrow, I will let you take mathematics for an optional subject. Otherwise, you need to join another group - History*." He started to write symbols and formulas on the board, and commanded us to copy. It was the first time in my life that I had seen those symbols. The teacher just told us how to pronounce and recite them. I was so frightened that day. I needed to prove myself as one of the brightest students in the eyes of the teacher to study the additional mathematics.

You Must Memorize It!
There is no other ways to solve You must memorize it It is useful and applicable No matter what is it! Facts and postulates are unquestionable Definitions and theorems are unbreakable Problems follow a fixed structure And it is unchangeable We are no one to make our own processor!!

I could not make any sense about the trigonometric relations on that day. My primary concern was to recall those all trigonometric relations by the next day. It was not an easy task. The teacher sometimes used to give us the ready-made techniques to memorize the formulas. For example, the teacher wrote;

$$\text{SinA} = \frac{p}{h}, \text{CosA} = \frac{b}{h}, \text{TanA} = \frac{p}{b}$$

The teacher gave the techniques to remember this trigonometric ration in this way:

"*Pandit Badri Prasad Hara Hara Bole*"

Each initial alphabet of the above slogan P, B, P, H, H, B represents the alphabets of three trigonometric ratio in order from numerator to denominator. But, we were unlucky as we could not get any ideas to remember other formula on that day. When I reached home from school, I started to recite the formulas in a loud voice. I was permitted to prove myself as a capable candidate for additional mathematics. I went to bed at midnight after I memorized all the formulas. The next day, the teacher asked us to write the formulas on the board one by one. We all tried our best. Many of my friends could not reproduce them. As a result, they went for another subject - "History". "Thank God!" I could remember and write the formulas on the board. I proved myself a "bright student" in the eyes of the teacher. I felt as if I reached the top of Mount Everest. I still remember the teacher's statement on that day, he said, *"Mathematics is only for the bright students. You need to memorize all the facts and mathematical relations to solve the given problems in a limited time."*

The mathematics teacher was presenting mathematics as a collection of facts that should be memorized without any questions. Later, I came to know that it was the absolutist view (Ernest, 1991) of mathematics. The absolutist view of mathematical knowledge is that it consists of certain and unchallengeable truths. According to this view, mathematical knowledge is made up of absolute truths, and represents the

unique realm of certain knowledge, apart from logic and statements true by virtue of the meanings of terms (Ernest, 1991). Such behaviors of teachers helped us to create monological character, the belief that mathematical knowledge can be understood by a single way and the way is memorization of facts and practicing the same routine problems recurrently. While describing the traditional view of mathematics, Lerman (1990) mentioned,

> "Mathematics is a subject that is seen by most people and by most practicing mathematicians in particular, as the paradigm of knowledge-certain, absolute, value-free and abstract-with its connections to the real world perhaps of a platonic nature; but such speculations are in any case irrelevant in terms of its study and its development" (p. 3).

The above view is very pertinent in the context where I grew up. Many of the mathematics teachers are not exactly "mathematics teachers" in the school level. Some of them are college students who value procedural knowledge, routine-based problem without any pedagogical orientation. Most of the teachers are not subject teachers. A study report of DEO (2012) entitled "The status of teacher management in community schools of Nepal" showed that one of the most serious problems is the lack of subject teachers. It is difficult to get mathematics teachers in the school level who have specialized in mathematics.

I continued developing questions on mathematics and mathematics teaching. The initial moment of being a student of additional mathematics was very challenging for me in the sense that it was supposedly made to be tough. Due to the lack of culture of sharing problems with teachers, I had many questions within myself. Is mathematics a series of new symbols and relationship? Is mathematics only for bright (so-called bright) students? Is learning mathematics memorizing and solving problem

within a span of time? Can we not question on the existing mathematical knowledge? Is mathematical knowledge always true?

I Can Solve Mathematical Problems! I Am a Good Mathematics Teacher!

It could be any day in June, 1998. This was the time I was enjoying a lot after appearing my SLC exam. There was no homework, no any preparation for exams, no need to spend nights memorizing the notes. On the other hand, I was busy with household jobs. I was confident that I secured good grades in the SLC exam. One day, a group of my neighbors came to my house. I was working on the field nearby. One of the persons asks my father, "*Our sons and daughters are weak in mathematics. They are now in grade ten. Your son always stood first in school. Everybody praises that he is very good at mathematics. We are here to request your son to teach our kids."* Another person said, "*The school is far and our kids cannot go to Big Master's (the teacher who teaches mathematics in school) house. We pay money as we can. We beg your help. If our kids become failure in the SLC, their future will be dark.*"
"*He has just appeared in the SLC. He has not passed it. How can he teach Mathematics? It is not an easy task*," My father said. I was observing these conversations from the nearby field. My father immediately said, "*You please talk to him. If he is ready to help, it is okay. I have no objections." "Binod, come and talk,*" My father called me.

I immediately went to my house. I acted as if I did not listen to their conversation. I remained silent. One of my well-known neighbors said, "*Small Master, my Bhunte*[5] *secured ten marks (out of one hundred) in the previous test. Now, please help our kids*."

[5] The common nick name used by parents to their children

I was confused. How do I respond at this moment? I thought I could teach because I could solve almost all the problems from the textbook. At the same time, I thought I could not teach because I did not have any experience of teaching. Another neighbor distracted my silence, *"We do not know anything. We send our kids to your house from today in the evening. Help them to pass in Mathematics."*

"*I will try my best to help my sisters and brothers*." I showed my acceptance. I was happy that the neighbors trusted me. I was also sad thinking how they would take me if I could not make them satisfied with my teaching.

On the next day, five of my junior came to my house with some books and copies. I was familiar with them as my juniors in the school and as my neighboring friends in the village. We all sat on a mat. I was at the middle.

I asked, "*Which problems are not solved? Please ask me. I solve the problems and get the answer.*"

Binod brother, "*I do not know how to solve the problems of Unitary Method."*

"*I do not understand what geometric proofs are?"*

"I hate trigonometric identities. They cannot be proven although I give them sufficient time. I cannot remember the particular techniques for particular problems".

My friends raised many questions. I was expecting their particular questions but they were asking me as if I could help them make mathematics easier. I was at the state of dilemma. What to do? How to start? Whom to listen? I, then, immediately asked for a book. I decided to help them in the unitary method. This chapter was/is regarded as one of the most difficult portions. Our teacher also could not solve many problems in this chapter. In some cases, the teacher used to say that the answers were wrong and sometimes he used to convince us saying that some particular questions were not important for the exam. But, we understood that our teacher did not know

how to solve those problems. We wanted to see whether our teacher could get the correct answers rather than trying to make sense of those problems.

I wanted to give good impression among my friends showing that I could solve the mathematical problems. I knew that they were not satisfied with their mathematics teachers and they were themselves 'weak' in mathematics. This was a good opportunity for me to make my space, I thought. I asked one of the students to give his note copy. I copied one 'important problem' from the book highlighting that it was a frequently asked question in the exam. My friends paid attention, and they were ready to copy the solution. I solved the problem. I was confident with my solution. But I knew my friends did not believe till they matched the calculated answer with the textbook's answer. "*The answer matches with the textbook*" Bhunte said. I allowed a few minutes to copy the solution. All of them copied each line of the solution. I immediately chose another similar question from the book and asked them to solve. My friends followed the same procedure, changed the names and numerals, and finally got the answer. They checked the answer. They got the correct answer. They were happy.

I continued the same approach for about two months. I solved many problems from the textbooks, made students practice on the similar problems and helped them to memorize the process of the problems in many cases. I felt that my friends were happy with the way I 'taught' them. The hidden story was that I used to solve the problems alone before my friends come to my house. I sat with them with full of confidence after getting the correct answers. This was the way I started teaching mathematics. I thought I was a good mathematics teacher at that time.

When I reflect back on those days, I get stunned. A number of questions come to my mind. What sort of beliefs did I hold regarding mathematics teaching? Why did

I develop such disempowering beliefs about mathematics teaching? What made me such an uncritical mathematics student, and a very novice mathematics teacher? Why did my friends seem satisfied? Why did I celebrate such algorithmic ways of problem solving as the only approach in mathematics teaching? What were the hegemonic forces that could not allow me to think of some alternatives perspectives on mathematics pedagogies?

One of the major reasons could be that I never received mathematics as our own entity. The majority of the descriptions of the concepts were culture free. The examples of books were not taken from the society. The mathematical problems were dead except in a few exercises. I was taught by the ways that 'mathematics teaching is algorithmic problem solving'. My beliefs towards mathematics is that, Mathematical knowledge is made abstract by avoiding lived, felt and experienced realities associated with its process of knowledge constructions (Hersh, 2006). The deep-seated beliefs towards the absolutist nature of Mathematics (see Chapter III of this dissertation) shaped me to act this way: teaching as the transmission of knowledge. This entailed a belief in the importance of a collection of procedures or routines, particularly about paper and pencil methods, one for doing each particular type of calculation regardless of whether or not a different method would be more efficient in a particular case (Gates, 2001, p. 115). In this approach, students are taken as the empty vessels and teachers are the masters of knowledge.

There is a famous saying that 'we teach our students as we were taught by our teachers'. I was taught in the same fashion that 'mathematical teaching is all about algorithmic problem solving'. I did not blame my mathematics teacher about the ways of his teaching strategies though I was not satisfied with his inadequate preparation to solve the problems of textbooks, and get the correct answers. I thought

I was good because I gave enough time to practice the problems and to memorize the algorithms.

Now, I feel that I was overwhelmed by various disempowering beliefs about the teaching approach. Actually, I was grown up with a host of not-so-helpful pedagogies as transmissionist, reproductionist, hierarchical and elitist (Luitel, 2009). For a transmission-oriented teacher, if the teacher has explained a method clearly and logically, then any failure to learn must be the result of the student's inability rather than a consequence of the teaching (Gates, 2001, p. 115). So, I celebrated as a good teacher at that moment. The reproductionist view promotes the replication of the same culture assuming that cultural is an unchanging structure separated from individuals. This shows we are guided by a world view which Taylor (2006) terms "Western Modern Worldview". The Western Modern Worldview-guided curricula and education models upon their colonies have disoriented mathematics and science education in many Asian and African countries. We are reproducing the so called mathematical ideas borrowed from the western counties. On the other hand, why did I and our teachers not use local practices in mathematics teaching? In this regard, perhaps, we, with the neo-colonized mindset, could not be able to develop critical perspectives at that time. The other disempowering force was the practices of hierarchy among teachers and students. The teachers were taken as the ultimate sources of knowledge as Plato argued.

We, as students, could/should not raise the questions that are not pleasant to teacher. We were habituated not to ask off-track questions, their applications and against the standard procedures. Perhaps, we were extrinsically motivated for the higher grades in mathematics being a good listener in mathematics class and maintaining the hierarchy with teachers. I was lately aware about the elitist as

empowering forces in mathematics pedagogy. School mathematics is traditionally perceived as an elitist subject for more academically oriented learners (Namukasa, 2004). Many of my friends from so-called backward and minority communities would say that mathematics is only for Brahmin[6] and exceptionally bright students from other communities. They had deep-seated beliefs that they, as backward community members, did not have ability to learn mathematics and they were made to learn lower level skills. In this context, Skovsmose (1990) also argued that school mathematics has political implications as it favors certain groups of students, stratifies society, and serves as an introduction to an ideology characterized by certainty, idealism, and rationalism.

Let's Request Mr. Tips for Tuition Classes!

Now, I am graduated from the university. I am now academically qualified to teach mathematics for the secondary level students. I have the certificate of Bachelor's Degree in Mathematics Education with the highest grade of the batch. The first rank with the first division grades made me popular among my friends and in some private schools where I was in/directly associated with. I have been teaching Mathematics for school students and learning mathematics in colleges for many years simultaneously. When I received certificate of Bachelor's degree, it helped me a lot to approach reputed private schools and to bargain for the handsome salary with the tag of 'college topper'. Thanks to my grades! It supported me to get a job in one of the most high-ranked schools in Dhulikhel and received very high salary in comparison with my contemporary colleagues. I started to teach compulsory and optional mathematics for grade nine and ten. I was well aware that students, parents and school

[6] This is a so-called upper caste in Nepali society. The Brahmins were thought to be worthy for mathematics because of their access and ability to deal with classical Vedic knowledge, most part of which constitute logic, calculation, ritualistic hymns, and philosophy

administration were expecting good result in the SLC. “Mathematics is the subject that helps students to raise the percentages” everybody believed that.

“We are more than happy to get you as our mathematics teacher. You are taking two of the subjects (Compulsory and Optional Mathematics) with the help of which all of the students can get first division in the SLC. Sir, my only one aim is to keep the flex with “100% First Division Result in the SLC” in front of my school.” Mr. Principal shared his intention.

I was the youngest teacher, not only in terms of age, but also in terms of teaching experiences at school. Nevertheless, I was familiar with the contents of grades nine and ten, and students’ expectation and behaviors of this age-group due to my previous engagement of tuition classes of similar group. I was thus very motivated to produce good result.

I made a plan after taking a few classes. I gave a class test. I divided my students into three groups – labeled as ‘best’, ‘good’ and ‘poor’ on the basis of the result of the class test and the impression I had during the classroom teaching. I started to deal with them according to their supposed abilities and labeled group.

Let me take one example from the course content itself. If I had to teach statistics, I lectured definitions, some formula and the basic skills as the common core on statistics. Then, I dealt separate groups of students with separate set of problems on the basis of their pre-supposed ability to solve the problems. In many cases, I did not even introduce some of the chapters for the group of ‘Poor Students’. I always compared the importance of the particular lesson with the marks from which the questions were asked in the final examination. I can still remember that moment where I did not introduce the chapter ‘Vector’ for the ‘Poor Students’ since this chapter was introduced for the first time in the secondary level curriculum and it was

taken as the most difficult portion in the textbook at that time. In fact, it was also difficult for me as a teacher. I spent many days and nights to solve the problems on vector at home. I never shared with my students that part of my struggle. If I had shared such incidents, I knew that the students would not have taken me as one of the talented teachers. By the time I taught 'Vector' to the 'Best' and 'Good' groups of students, I gave problems of other easier chapters to the students of 'Poor' group to practice. One of the beliefs of teaching I was then guided by was "Practice Makes Men Perfect."

I focused on the problems that were asked frequently in the examination. I spent remarkable time to search and develop lots of tricks and techniques to solve the mathematical problems, to memorize the formula and to help students to keep in mind for longer period. This became my speciality among teachers. Once I completed once chapter, I gave a class test, and corrected copies in front of my students. The frequent class tests and timely responses encouraged my students to make them practice regularly and interact with the group members. I was very happy about the ways I was teaching. Mr. Principal seemed happy with my energy and commitment to improve the result in Mathematics.

One day, I was correcting students' homework in the staff room. One person came to the office. He asked, "*Where is Math teacher? Can I talk to him*?"I looked at him. I was about to speak. One madam pointed to me and said, "*He is our Maths teacher*."

"*Sir, Namaskar. I am a parent of 'Miss Failure'. I want to talk with you."* Mr. Parent said.

"*Namaste, please be seated."* I said.

Without waiting for my response, he started to speak.

"*Sir, my daughter never passed in Mathematics tests. We have been tormented due to her study. These days, she says that she is improving. She also passed in the recent class test.*" He said expectantly.

"*It's okay. What else do you need now*?" I asked confidently.

"*Sir, she is happy with the ways you teach. We are now hopeful that she can pass in the SLC. She sent me to request you to take tuition classes. I think some additional time is needed for her. Will you please help her with some additional time?"* He requested.

I was already busy with some other private tuition groups. I used to teach about twelve hours a day. I could not manage time for new students. I did not refuse directly though I could not manage time. I replied, "*Your daughter does not need any extra classes now. She is improving gradually. I am sure she can pass with average marks*."

The parent frequently requested me to give private tuition for his daughter. He was ready to pay as I demanded. After having discussion about an hour, I convinced him there was no necessity of additional classes for her. This was the time where students and parents came to me for tuition classes. Many of them believed that I was a good mathematics teacher who taught mathematical problem in a piecemeal way. Perhaps, that was the time when I was highly satisfied with my identity as a teacher.

Today, when I reflect on the above narrative, I solicit answers from myself to depict my beliefs and practices of good teaching as a novice high school mathematics teacher. I, then, try to make sense of those acts together with critically examining those episodes as a researcher. At this point of time, my belief towards the nature of mathematics was '*Mathematics as problem solving'*. I have discussed this conviction in Chapter III. Now, my plan is to discuss the pedagogical aspect of those beliefs and

unfold the relation between my beliefs about the nature of mathematics and its pedagogical facet.

I was in favor of homogenous class at that time. I did not believe that learning could take place in a heterogeneous setting. My limited belief in learning mathematics was to solve a routine mathematical problem. For this, so called poor students and talented students should be separated. I took the students from various interests, background and supposed abilities as constraints to each other rather than strengths. At that time, I was not aware about collaborative approach of mathematics teaching in which students are not segregated according to supposed ability, achievement, interests, or any other characteristics. Segregation seriously weakens collaboration and impoverishes the classroom by depriving all students of opportunities to learn from and with each other. On the other hand, it may be due to the teachers' struggle with the complexity of heterogeneous classes, and that they find it easier to teach ability-grouped classes (Steel, 2005). I partly agree with Steel (2005) in terms of complexity of a heterogeneous class, but is it not impossible. If we arrange manageable groups in the classroom, it will be helpful to conduct live discussions. Prytula and Weiman (2012) claimed that when students work in small groups, all claims need to have a reason, be explained and discussed; everyone has to have a chance to talk, justify, and prove his/her conception. It is perhaps a crucial question that what I was teaching to children: problems for the sake of problems or/and to develop reasoning skills. In this regard, the idea of Schifter (2011) is appropriate, who emphasized teaching driven towards helping children to reason quantitatively through considering the effects of operations on numbers, rather than practicing operational procedures through lists of calculations. The notion of problem solving approach has now radically shifted from algorithmic problem to contextual and

critical reasoning. Many years back, the popular approach suggested by Polya (1945) also proposed "Heuristic Approach" in problem solving in his popular book *How to Solve It?* I think I have not been able to use Polya's ideas in this modern era.

Sir, Leave the Score! How Is She in Mathematics?

I was teaching mathematics in one of the reputed private college of Kathmandu valley offered by Cambridge University, UK. The course was offered under the program of A Level, which was equivalent to Nepalese Higher Secondary Level. I was fortunate to teach in the A Level program in one of the reputed private colleges of Kathmandu Valley. It could be any day of July, 2012. Sometimes, I felt proud that the college selected me from more than two dozen candidates. It was the same year I completed my Master's degree in Mathematics Education from New Age University.

"*You are selected as an A-level teacher due to the loyalty of the degree of New Age University*." Some friends said.

"*It is due to your continuous effort in teaching for many years*" some friends congratulated me believing in my capabilities.

I convinced myself thinking that I was selected neither just because of my capability nor only due to the loyalty of my certificate; it may be due to synergy of both. One day, I felt somewhat unusual. I was going to deal with the parents of A-level students in the college. I heard that some parents were highly educated and many of them had good schooling. It was the Parent-Teacher-Conference (PTC) day after the first terminal exam. I reached the college on time. All the faculties and staffs were dressed smartly. I took my students' files with answer sheets. I took my seat. I was waiting for my parents with a sip of tea.

"*Sir, Namaste. I am a parent of Mr. Harish. Will you please give me his mark-sheet*?" One tall and moustached parent said.

"*Namaskar, Please be seated*," I replied.

I gave the mark sheet of Mr. Harish. His parent observed the grades carefully. There were two Es and two Us. (The E grade refers to the marks obtained within the range 40-50, and the grade U refers to Ungraded, which is equivalent to failure in many cases). It is considered poor result. The parent made his face red, looked unsatisfied with the result of his son.

He added, "*Sir, I have paid handsome tuition fees. How do these grades appear in his mark sheet? It is not tolerable for me*."

His initial response made me think that he was eagerly worried with the grade rather than the status of his child in studies. He was not expecting my response.

"*Sir, it is the first examination he appeared in this system. He is unfamiliar with the question pattern. He may improve in the days to come*." I tried to empathize him with encouraging words. But he was not convinced.

"*Sir, I know my son very well. He requested me to admit him in A-level program as the last opportunity. He gave me lots of pains during his study*." He shows his helplessness.

I was trying to console him. But, he did not listen to me. He folded the mark sheet, kept that inside his pocket and left the station. As there were many parents waiting in the lobby, I also did not force enough to stop him and make him listen to my suggestions.

Oh! I am wrong. My expectation towards the A level parents was something else; who value learning process rather than the grades only.

"*Good morning Sir!"* another parent entered the room with his daughter.

Showing the chairs on the side, "*Good morning sir, please take your seat*." I politely exchanged the greeting.

"*Sir, I am Mr. Diplomat, her father (keeping hand in his daughter's shoulder)".* The parent proudly introduced him. "How is she doing?" He spoke promptly.

"*Let me see her grades*." I started searching her mark sheet from the bundle.

"*Sir, it is her first attempt in such written tests of Nepalese System. I don't think she secured good grades at this time. I just want to know how you teach mathematics here. How is she performing in the class?*" He did not show any interest to see the mark sheet.

"*Where did you do your schooling*?" I expected response from the student.

The parent looked at her daughter. The daughter smiled and perhaps requested her father to answer through her body gesture.

The parent said, "*We all were in Finland for the last ten years. She completed her schooling in Finish Education system. I completed my doctorate degree from Finland. I also worked there as one of the diplomats in Education section in Nepalese Embassy."*

Oh, my God! He was a highly educated person. I have read some papers on education system of Finland, which is considered to be one of the most successful models in the recent years.

I was happy and scary at the same time. I was happy as I met one of the scholars as my parent so that I could be in touch, and could be beneficial in academia. I was scary as I might not be able to on a par in discussion with him.

"*It is a nice meeting. I do hope that I will learn many things from you.*" I accepted his expertise.

"*I also teach in New Age University as a visiting faculty. Teaching is not only my profession. It is my passion*." I indirectly presented my scholarly attachment.

"*Sir, there are many parents waiting outside. They all want to meet you to know the status of their children in Mathematics*". Mr. Coordinator interrupted our discussion.

"*Sir, I will meet you later. It seems that you are too busy today*." He stood with this saying without waiting my response. Perhaps, Mr. Diplomat was not expecting any more from my side.

"*Will you please provide me your mailing ID so that we can be in touch?*" I asked.

"*Sure, I would love waiting your e-mail*" he said handing me his visiting card.

The result day was over. A part of my mind was recalling the conversation with Mr. Diplomat during the whole day. I decided to write an e-mail. I reached my home in the evening feeling exhausted. I opened my laptop, and composed a mail carefully. The content of the email looked like this.

To: diplomat@gmail.com

Subject: Hello!

Dear Diplomat,

Namaste!

I was glad to meet you this afternoon. I enjoyed our talk though it was very short. I was so excited to talk with you and sadly I forgot to give you the report card of your daughter. I am sorry I could not talk much about the studies of your daughter. Though she is not able to achieve good grades at this time, I am sure she will do better in the next term.

As I am a student of Education Discipline in general, and Mathematics Education in particular, I am interested to be familiar with the ways of teaching in

Finland. Will you please share your experiences or/and some of the papers so that I can be benefitted.

Hope to see you soon.

Best Wishes

Binod

After two days, I received a reply from Mr. Diplomat. The content of the e-mail looked like this.

Re: binod@gmail.com

Subject: Hello

Dear Binod,

Namaste!

It is good to know positive response from your side regarding our last conversation. I guess my daughter could not do well in the last test. She is struggling much to appear in lengthy written tests as she is not habituated in such evaluation systems. I never force her to achieve better grades in the exam. I always encourage her to participate actively in the classroom discourse and activities, and develop conceptual clarity of the contents. Hope she will do better in coming days.

I am pleased to know that you are committed to teaching profession. It is good that you are interested to know more about Finish Education System, especially in their teaching and learning approaches in school level.

Please find some documents and links that are related to Finish Education in general and mathematics education in particular.

Best wishes

Diplomat

I downloaded the papers, visited the links and wrote my understating on Finish Education System focusing on the pedagogical aspect.

During 1972, school mathematics curriculum of Finland was influenced by the movement of "New Maths" which was popular in the US during 1960s. Later, Finland adopted "Back to Basics" and "Problem Solving" movements in mathematics curricula. Both of these movements were adapted from the US practices. Till then, Finland was not performing outstanding in school mathematics. In 1994, the National Board of Education (NBE) issued a new Framework Curriculum for the Comprehensive School. It was the turning point of Finish Education System. Schools were given more freedom and responsibility for their own curricular preparation and development. The comprehensive school is for child and, hence, has to adjust to the needs of each child (Kupari, 2008). The focus is on learner, not the contents. There is a notion of humanistic mathematics.

I think I am a Failure!
I do teach mathematics I do solve problems I do get correct answers But … I think I am a failure! I do write textbooks I do train teachers I do attend seminars But…I think I am a failure! My students do secure distinction marks They do memorize all the facts They are outstanding at writing mathematical syntax But….I think I am a failure! I could not find mathematics of my community Neither could I find it of students' locality I drew cylinders with markers on the board Never did I show markers as cylinders So, I think I am a failure! I never observed my mother's estimation of work Neither did I acknowledge my father's calculation of force I thought I was a very good mathematician Who cares the local compendium? So, I think I am a failure!

Many mathematics educators (such as Hersh, 1979; Brown, 2002; Ernest, 2013) raised promising voices for improving mathematics education at all levels, termed as the "humanistic" approach. This approach is not new and variations of it have been used by a good many teachers since the time of Plato. Humanism as a school in philosophy of mathematics was introduced by Reuben Hersh in about 1979. According to Hersh, a world of ideas of socio-culture which is created by human beings as part of their shared consciousness, and that mathematical reality is neither mental nor physical. Humanistic mathematics attempts to explore the human side of mathematical thought and to guide students through mathematical ideas by the use of imagery, history, internet and computer tools to discover the beauty of mathematics.

This idea made me remember one incident. I was talking with an Australian Professor regarding difficulties of teaching mathematics, students' low motivation, etc. He asked me*, "what do you teach"*? I proudly said that I teach Mathematics. "*Please, teach children, not mathematics*" he said.

I did not get him at that time. Later, I got what he wanted to tell me. I agreed with his response. We have a tradition that focuses on contents rather than the students.

In Finland, teachers have also been trusted as true professionals. Finnish teachers have considerable pedagogical independency in the classroom and that schools likewise enjoy substantial autonomy in organizing their work within the limits of the national core curriculum (Välijärvi et al., 2007). Teachers make their own decisions related to the conduct of the teaching and learning process. They are responsible and competent for developing the local curriculum, choosing teaching methods and selecting learning materials to be used. Many teachers prefer hands-on materials, projects, practices, etc. in mathematics classroom.

The Finnish comprehensive education system is not only a system. It is also a matter of pedagogical philosophy and practice (Kupari, 2008). Finish Education System has given much priority to pedagogical practices. It is believed that Finish Education is successful due to the teachers' efforts. They are highly motivated and responsible. They are free to use any sort of teaching approaches that assist students' learning. Finland success has been attributed to the idea that children are given much care and they are taught through integrated subjects.

Here, I am not arguing that Finish Education System should be taken as the model and we should copy them. Instead, it can be one of the alternatives we can think of, and may be their experiences may help us to develop our own useful pedagogical practices.

Please Sir, Give Us the Best Techniques of Teaching

It could be any day of March, 2012. I was teaching in one of the reputed private colleges as a full time faculty and in New Age University as a visiting faculty. I was involved in some publishing houses to develop reference books for school mathematics. I sometimes got opportunity to deliver teacher training sessions at different organizations. One of the publishing houses arranged a training session for secondary level mathematics teachers at the north outskirt of Kathmandu Valley. The hidden purpose was to advertise our recently published "*Mathematics Practice Book*" among the mathematics teachers. I purposefully selected the theme, "Effective Ways of Teaching Mathematics" to make it appealing so that a huge mass could be gathered.

It was about 10 am. I entered the hall. The multi-media were ready. A bundle of "practice books" was on the front. The hall was full of teachers. Many of the teachers seemed novice. I knew forty teachers were in the hall. The organizer broke

the silence of the hall with my introduction. "*Mr. Trainer teaches in the university and some colleges. He presented papers in some of the national and international conferences. He is also a book writer. You will get the books written by him after some time. I, now, request Mr. Trainer to deliver the session.*" One of the organizers introduced me. I was confused whether he introduced me or the recently published practice book.

Anyway, I began my job. Though I put "*Effective Ways of Teaching Mathematics*" as the theme of the training, my intention was to discuss something else. At that time, I was convinced that there were no absolute ways of teaching mathematics which could be named as effective methods. I was searching a convincing approach to get into my deliberate topic. I made four groups and assigned them with the task to discuss and share their beliefs about the effective ways of teaching school mathematics. Initially, they seemed confused. Perhaps, they were expecting my lectures on the topic and some useful skills that could be easily applied in the classroom teaching.

"You all are in-service teachers. You have experiences of teaching in schools. Please discuss the effective methods that you felt. I will share my thoughts later." I encouraged each group members to participate in the discussion.

After a few minutes, they seemed ready to share their group discussion.

One of the teachers representing the first group started sharing.

Sir, we all know that mathematics is a difficult subject. We should give students lots of techniques to memorize the formula and steps of some important problems. There should be many tricks and ways to teach mathematics. One cannot learn mathematics till s/he practices regularly. We think that the best way is to teach how to make students practice. We are struggling hard to teach secondary level mathematics.

Most of us are the beginners for secondary level school mathematics. The students ask how to prove geometric theorems, how to memorize the formula in trigonometry, how to remember the tricks and techniques to prove trigonometric identities, how to give concept on vectors and functions?

Sir, you have long experiences in this field. You are a book writer, and a teacher trainer. We are here to listen about the best techniques of teaching so that we can apply in the classroom. Please, give us the best techniques.

I asked other groups to share their beliefs on the effective ways of teaching. The rest of the groups shared similar beliefs. I did not find any beliefs from other perspectives rather than searching the tips and tricks. I came to know that almost all of them were searching for the best techniques, which could be given by the trainers/experts. Those techniques could be easily taken by the teachers, and be applied in classroom as the trainer's prescription.

It was very difficult time for me as a trainer. I was expecting something else so that I could refer to their beliefs and continue to discuss that idea. That day, my intention was to talk on "Self-reflection in Pedagogy". But, the arguments of the participants were very far from the ideas of self-reflection. I made an adhoc decision. I asked half of the participants to remember one of their "Best Classes" and, the other half one of their "Worst Classes". I noticed that all of them confusingly looked at each other, hoping the next person would break the ice. Some of them might have thought that participation in such nonsense activities was worthless. Without giving much time to think, I asked them to share one experience from "Best Class" and one from "Worst Class".

"*Sir, when I taught vector first time for grade nine, I could not make students able to understand. Not a single student solved question from Vector in the class test*." It was my worst experience, one participant shared.

"What did you learn from this class? Did you progress later while teaching Vector?" I immediately asked him.

"Of course, I reflected on my class. I came to know that I was not well prepared at that day. I searched some of the examples and consulted with my seniors on what to teach on the topic "Vector". Now, I feel comfortable to teach this lesson, and I believe my students also understand better," he replies.

Thanks God! He captured my words.

"*Do you regularly reflect on your teachings*?" I further asked focusing on his response.

"*Yes, I do. Perhaps, we all do this."* He tried to generalize this looking at the mass.

I looked at my watch. I was running in second half of my time. I had not started my sessions yet. I thought I needed to stop the sharing session. I set enough background on the topic I wanted to talk about. However, I had neither asked other participants to share their experiences on "Worst Class" and "Best Class" nor did they seem interested.

"*I want to thank all of you for your active participation. I, now, want to begin today's session*." I began my presentation formally.

I tactfully dealt with the published theme and the intended theme. The first slide looks like this.

Effective Ways of Teaching Mathematics:

Self-reflection in Pedagogy

Binod Prasad Pant

Author, The Grate Publication

Date: 4th March, 2013

"*Although there could be many effective ways of teaching, today we are going to discuss self-reflection as an effective way to improve our practices*." I started discussing the contents of the presentation slides. I completed my sharing rapidly. Due to the limited time, I could not share examples and some ways of reflection on that day. In fact, I did not enjoy myself though I tried my best to capture the basic things I planned.

I completed my session. Some participants passed compliments on my session. Some asked me about the solution to some particular problems. I often see beginner teachers who come to the training session with some difficult problems. I try to make them happy. The publisher provided me with a list including the names of the participants, their e-mail ID and contact number. The day was over.

When I returned my home, I reflected on my session. Did the participants get what I intended? Of course, they might have benefited little, but it is not sufficient. I could not manage time for the second half. I have their e-mail ID. Now, I shall write a letter to the participants so that they can be benefited in regard to improve their practices of teaching through Self Reflection.

Dear Friends

Namaste

I do hope that this e-mail finds you well. I enjoyed today's session on "Effective Ways of Teaching Mathematics: Self Reflection in Pedagogy". Perhaps, you too

found it useful. The notion of Self-reflection cannot be captured in a short session. I tried to share with you many things, but could not. Some of you have shown deep interest in these ideas during/after the session. So, I am writing this e-mail to supplement further on the ideas we discussed today. I do hope that you find it commendable.

Dear Friends,

Self-reflection is about thinking over own actions and acting in interaction with the environment, and with the colleagues, which can have inner dialogue with him/herself. While doing so, it creates a sense of empowerment, self-realization and solidarity with the teachers. So, it is taken as an agent of change (Artzt &Armour-Thomas, 2002). I believe that the better teaching approach cannot be generated over night; it is neither a ready-made stuff to apply as it is from someone experienced nor is it a skill that can be developed from a session in a conference or through training. In this context, I remember one of my favorite writers Parker Palmer (1998) who mentioned that, if we want to improve the quality of college teaching, a million workshops on methodology will not be enough. Good teaching does not come from technique. It comes from the identity and integrity of the teacher. Teaching is a continuous process, which can be developed through observing ones' own practices. Today, many of you asked me to share the best tips and techniques of teaching. I also used to think the same in the beginning. I spent many years looking for the best techniques believing that there are techniques that last forever. Today, I do not believe and strongly suggest you all not to agree on this. We need to search better techniques through self-reflection, but not the prescribed techniques. Van Manen (1991) warns educators that in our pedagogical living nothing is ever completely foreseeable,

predictable, and manageable. It is usually not until afterwards that we have the opportunity to think reflectively through the significance of the situation.

Reflection is definitely a vital skill as it can be considered to be a key to teacher development. It can be either intuitive or systematic and organized; it enables teachers to become aware of their limitations and strong dimensions. Pollard and Tann (1993) believe that the process of reflection feeds a constructive spiral of professional development and competence (p. 4). Absence of such awareness would make growing further of a teacher impossible.

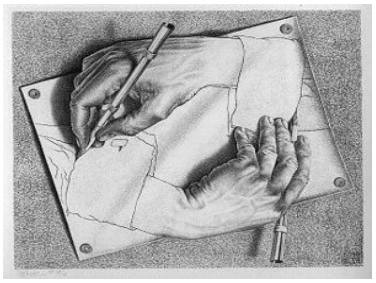
As a teacher, we normally follow the schedule of our institutions, we go into the class, spend the allocated time with the students, sometimes give time for assignment correction, leave the class after the bell rings, conduct tests as per the calendar routine, meet with the parents, etc. We try to follow our institutional calendar. In my opinion, these actions are routine actions. There is difference between routine action and reflective action. Dewey (1933) has distinguished between "routine action" and "reflective action". Routine action is influenced by "tradition, habit and authority and by institutional definitions and expectations….it is relatively static…" while reflective action demands desire to think over one's actions and work on his/her development which "implies flexibility, rigorous analysis and social awareness" (p. 14).

I want to share three types of personal reflections (as discussed by Pesci (2009): autobiographical reflection, reflection of own classroom practice and reflection on specific mathematical contents.

Autobiographical Reflection

Every teacher was a student of a time. A teacher has various experiences of several years as a student, and may be as a member of different stakeholders. In

autobiographical reflection, a teacher writes his/her personal relationship with mathematics, with the reference to his/her history as a student, as a teacher, may be as a parent and so on. While writing the professional stories of the teacher, s/he can use different metaphors, such as "mathematics teaching is like entering into a forest, or a challenging game, or a long marathon, etc.". The other teacher might write, "Mathematics teaching is like swimming, playing a game or listening to music. Here, two of the teachers have expressed their views in a different way. Writing an autobiography provides opportunity to know self - interacting as a mathematics teacher. It also helps to explore a series of personal stories, critical moments, and the changes occurred in personal life. Personal experiences, challenges and triumphs can raise a voice so that others in similar situations may gain better insights. Autobiography has deeper didactic designs beyond the surface narrative, we might try to mine them for insights into the reality of the self's transformation throughout life, and the underlying factors that shape that transformation (Scott, 2015). So, I suggest all of you to begin, if not, to write your own past experiences of teaching.



Reflection of Own Classroom Practice

Teaching is a complex job. I do not believe that participating at workshops and conferences develop professionalism in teaching career. We, teachers of mathematics, have to commit to the continual improvement of our teaching practice and take opportunities for our personal professional development. For this, reflection towards our own practice is mandatory. I envisage that self-reflection can help pacify

the extremeness of criticality by pointing the finger at self-practices (Gay & Kirkland, 2003, as cited in Luitel, 2009). I sometimes go to the classroom with a tentative plan; how to begin the class, what activities do I conduct, how do I present the ideas, what do I expect from my students, and what methods do I apply for evaluation, etc. Unfortunately, for many days of my initial teaching career, I could not apply my plan in the classroom. In those days, I took myself as a weak planner or sometimes a weak implementer. Later, I gradually realized that the teaching would not be appealing if it always goes according to pre-assumed situation. Reflection towards our own action helps to shape the more appropriate planning in further class. Reflection does not mean only seeing the past practices; it is about searching better alternatives. It is an ongoing professional practice.

Reflection on Specific Mathematical Contents

In such reflection, teachers reflect on the mathematical contents that should be taught in the class. According to Beswick (2012), teachers' mathematics knowledge is generally problematic in terms of what teachers know, and how they hold this knowledge of mathematics concepts or processes, including fundamental concepts from the school mathematics curriculum. They do not always possess a deep, broad, and thorough understanding of the content they are to teach. This is extensively found in developing countries, where teaching career is not taken as the prestigious job, and teachers are not highly motivated.

So, I humbly request you to begin reflective practice at least the above three dimensions of self-reflection from today onwards. It will surely help you identify your weaknesses, strengths, and you can develop possible "tricks", "tips" and "techniques"

that can be applied and you can revise them in your contexts as most of you have been looking for the same.

I do hope that we will be in touch and share our experiences with one another.

Cheers!

Best Wishes from

Binod

Envisioning My Mathematics Teaching as a Political Act

"*Teaching is a political act in general, and mathematics teaching is entirely political. I am doing politics here. We all are doing politics in one or other ways from our place."* Prof. Caring began one of our post graduate classes.

It could be any day in July, 2012. This was the class where Prof. Caring frequently challenged us with new ideas and perspectives in mathematics teaching and learning. In many cases, we felt difficulties to get our Professor. The same thing happened that day. In fact, I (perhaps we) were not convinced that teaching to be a political act. But I did not show my unacceptence. I was waiting for the suitable moment to keep my reservation or/and ignorance on this idea. I believed that teaching was purely a professional activity. We teachers should not get into politics. If it is so, how can we do politics while teaching? How is Professor doing politics in the class? I was confused. We all remained silent. Perhaps, the Professor read our faces and might have guessed that we were unaware about this issue. Then, he asked, how many of you agree with the view that teaching is a political act? Nobody raised hand. All seemed to disagree.

"Oh! It's interesting. Now, I begin with "What is politics?" Prof. floated this question.

"*Politics has certain agenda and doing politics is promoting the particular agenda*." I immediately replied.

"Don't you think that we have certain agenda as mathematics teacher and we are promoting those agenda through classroom teaching?" Prof. linked my response with mathematics teaching.

I was thinking about how to respond to him. One of my friends helped me to respond to the Professor, "*I do not think we have separate agenda. We all teachers have the same agenda in teaching mathematics. We teach mathematics to our students. How do we promote our agenda there?*

"Hmm! I think I am wrong today. How can I convince you?" He laughed.

"*Sir, it is due to that you are trying to link politics in an apolitical discipline*?" One of my friends spoke promptly.

We all laughed.

Let us do one activity. "*Will you please select one of the most important and useful topics from school mathematics curriculum of Nepal and suggest some ways of teaching the selected content*?" Professor assigned us an individual task.

We all were familiar with school curriculum. We were somehow familiar with the ways of teaching. I selected the topic "Profit and Loss". I suggested group discussion and project work as teaching methods. After we completed our task, Professor made a chart and wrote all the topics that we preferred and the ways of teaching we suggested. Un/fortunately, we all had chosen different topics and different ways of teaching.

"*Look at the chart, I asked you the same question, but you came up with different responses. No responses are the same. You all are from different "parties". You are posing your agenda in the name of useful and important topic*." Professor explained.

We liked the ways our Professor Caring engaged us in such activities and tried to concretize sophisticated construct in a very simplistic way. This was how he introduced teaching as a political activity. After this discussion, he shared some of the literatures on socio political turn in mathematics education, and its consequences in mathematics teaching. Professor Caring gave us different themes to prepare and share in the next class.

"*You need to speak in front of the class on the assigned themes. It is like oratory. You can come up with the notes that you prepare*." Professor wrapped up the discussion and ended the class.

My theme was "*Critical pedagogy and teaching mathematics for social justice*". I collected papers through various sources including the papers provided by my Professor and reviewed them. I was prepared for the oratory. The following week, on the stipulated day, the class began. Some of my friends delivered influential speech. I was waiting for my turn. Professor allowed me to proceed.

Respected Professor and my dear friends,

I am standing here in front you to share my understanding, discuss and critically assess the notion of critical pedagogy and teaching mathematics for social justices. Though I agree that teaching mathematics is a political act, but my take is that we should do politics for the betterment of the society. As far as I understood, critical pedagogy is a tool for "teaching as a political act." Critical pedagogy is celebrating its 45th anniversary as Paulo Freire (1970) is credited as "the inaugural philosopher of critical pedagogy". Freire seminal work, "Pedagogy of the Oppressed" created enough grounds for critical pedagogy although Giroux (1983) used the term critical pedagogy in his book "*Theory and Resistance in Education*" for the first time. When I read Freire, I was much influenced by his ideas of "critical reading" in which

the investigators become subjects in an ongoing process of quest for the revelation of the 'why' of things and facts" (1994, p. 105). The purpose of critical reading is not just to make sense of words; it advocates a dialectical reading of the word and world, so as to write the word to rewrite the world (Stinson, Bidwell, & Powell, 2012).

Dear Friends, let us reflect on our understandings of reading. Perhaps, all of us read to get the plain meaning of the words. At least, I have been doing the same. We, students and teachers, now should not be viewed as knowledge seeker and knowledge provider. We should act as an agency as conscious beings. Giroux (2007) argued that critical pedagogy motivated both critique and agency—for teachers and students alike—"through a language of skepticism and possibility and a culture of openness, debate, and engagement" (p. 2). The notion of critical pedagogy, I think, is more useful in our Nepalese context where we have been influenced by "westernization and universalisation in the name of globalization" (Luitel, 2009).

As this room is full of M Phil scholars, you might be thinking about what the epistemological and ontological beliefs that critical pedagogy hold. The teacher acts as dialogical educator that creates pedagogical spaces for epistemological curiosity where students (and teachers) become apprentice in the rigors of exploration (Freire & Macedo, 1996). The students and teachers reject singular explanations that attempt to provide a locus of certainty and certification around the social constructs. In case of critical ontology, Kincheloe (2003) stated that teachers and students develop a critical ontology that assists them in understanding how and why their political opinions, religious beliefs, racial positions, gender roles, sexual orientations, and so forth have been shaped by the power relations and ideology of dominant groups. One the other hand, I am not blindly supporting the ideas of critical pedagogy. It is not a one-size-fits-all pedagogy but rather a humanizing pedagogy that values students' (and

teachers') background knowledge, culture, and lived experiences (Stinson& Wager, 2012).

Respected Professor and Dear Friends,

Let me share how we can use critical pedagogy in mathematics teaching for social justice. "Teaching for social justices" is not same for all scholars. So, North (2006) explained this idea as complex, multi-layered, and often contradictory. Gutstein (2006) identified teaching mathematics for social justice as having two dialectically related sets of pedagogical goals: one set focuses on social justice and the other set focuses on Mathematics. Social justice pedagogical goals are further divided into three sets: reading the world with mathematics, writing the world with mathematics, and developing positive cultural and social identities.

There are relations of power, resource inequities, and unequal opportunities and explicit discrimination among different social groups, and the purpose of pedagogical goals should be viewing those social structures (i.e. world) through the lens of mathematics. Let me give you one example of our locality. How people become powerful in the society? May be due to the resources s/he has. The resources may be education, money, position, etc. Cannot we analyze the un/equal distribution of resources from the perspectives of mathematics? Cannot we bring awaking examples from our society rather than trying to make alive those problems that were already dead many decades back? The second point argues that the purpose of learning mathematics should not be only learning mathematical facts, postulates and problems, it should advocate for better society. That is what Gutstein (2006) said writing the world with mathematics in terms of transformation of the world. In the name of modernization, many rich cultural practices have been lost. This ultimately vanished the social identities. In this case, mathematics instruction should be

grounded in the students' languages, cultures, and communities to survive and thrive in the dominant culture.

Dear Friends,

Critical pedagogy is most helpful to empower our students and to be aware of disempowering beliefs, practices and identities. I think one of the purposes of this approach is to cultivate emancipatory knowing (Habermas, 1972) of our children.

Thank You!

Chapter Summary

In this chapter, I portrayed my narratives keeping the issues of teaching and learning mathematics at the centre. I began my narratives describing how I started as "good" mathematics teachers as a problem solver of routine and decontextualized textbook problems. With the help of my narratives unfolding my lived experiences as a "tricky teacher", I tried to discuss how a teacher uses readymade techniques of remembering and solving mathematical problems as better pedagogical tools to promote monological views of teaching mathematics, and the culture of taking experts' prescription as the ultimate ways of teaching. I gave enough spaces to discuss self-reflection as a tool to improve pedagogical practices rather than searching the tips and techniques provided by other people. The interaction with an educated parent, who was interested to know his child's interaction inside the classroom rather than grade, was a turning point to reflect my own beliefs and practices of teaching and learning mathematics with the stories of other successful countries about school mathematics.

Assessing my long journey with deep-seated beliefs on conventional ways of mathematics teaching got revised with the very powerful metaphor; teaching as a political act. Here, I understood the notion of politics in the field of mathematics

teaching for the betterment of the person and the society. The purpose of mathematics pedagogy should not be only to produce algorithmic problem solvers. It should aim to see the world from the perspectives of mathematics, and then the students should work towards writing the world mathematically (i.e. to nurture social justice, democracy and inclusion in the society).

CHAPTER VI

SHIFTING MYSELF FROM ASSESSMENT AS SPORADIC TESTS TO CREATING PORTRAYAL

"This is not a good percentage. Whatever you have in your mind does not guarantee your future; good grade in the mark sheet seems to be ultimate for your career. You seem okay in the classroom participation and problem solving. But you always secure low grades in the test." Mr/Ms Conventional lectured in 1990. *"You always try to memorize the formula and procedures of some routine problems. You perform well in the written test. But your conceptual clarity and relational understanding is poor which does not help you to be a creative and critical citizen. Try to think out of the box and cultivate creativity within you. The grade does not survive you in this age."* Mr/Ms Smart will share in 2020.

The notion of assessment has been drastically shifted from a conventional way of giving a test to the multiple authentic practices (such as Continuous Assessment, Performance Based Assessment, Portfolio Assessment, etc.) for some years, and it has grabbed careful attention of many scholars in academia. In this chapter, I have addressed my fourth research question: *how have I been developing my beliefs and practices in students' assessment, and how do I envisage the better assessment practices that promote assessment as an inseparable and continuous part of teaching and learning?* I, as a teacher and a teacher educator, have been engaged in a series of assessment strategies, and slowly progressing in my academic journey. I am still thoughtful about envisioning the better notion of assessing the children's learning. In

this context, I engage myself with the epiphanies of my professional life regarding my perception and practices of assessment to address the fourth research question.

This chapter includes six sections; You Are at the Iron Gate!, Sir, Where is the Pass Marks in the Question Paper?, "Experts" Prepare Questions!, This is Your First Day: We Do Not Evaluate You! We Assess You!, Questions Are Out! You Have One Week to Answers Them!, How Does She Survive with Grades Only? Where are Projects and Practical?.

You Are at the Iron Gate!

It was the year – 1997/98. I was at the uppermost grade of the school. I was in grade ten. I stood first in all the grades in my schooling in almost all the internal and end year exams. I always expected the first position whatever the grades I secured. I was happy expecting that I was going to the town area for my college study. I was just waiting for my exam - the long awaited moment – the SLC exam. Perhaps, it was/is like one of the most popular national festivals in terms of its popularity and revealed as the most challenging national board exam taken at the end of tenth year of schooling in Nepal. Everyone gives high priority to this exam – government, teachers, parents, family and the individual self who appears this test.

"*Binod, you are appearing the SLC exam this year, you must study hard*," teachers said.

"*My son, you need to prepare for SLC exam this year. You cannot attend any ceremony this year.*" Mother frequently gave advice.

"*Babu, you are at the Iron Gate in this year. You need to be serious on study."* My relatives frequently warned me.

"I am sure you break the previous record of our school with the highest percentage." My head teacher's repeatedly shown anticipation always stroke my mind.

"The questions are ready for the SLC exam. The exam centers are about to be disclosed. The government completed almost all the arrangements to conduct the SLC exam smoothly. If the students are found with any unwanted behaviors, they will be punished." The Radio Nepal – national media – frequently broadcasted the news.

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"Binod, why are you doing homework? No one counts your homework now. Our teachers neither prepare question papers for the SLC exam nor do they correct answer sheets. They do not have any roles now." Mr. Ambassador came to my desk in the break time and convinced me not to do homework. He was very clever. He would secure average score in the test. He would not do homework himself. He would rather copy it from friends' notebook, but would submit on time. If any of our friends had some problems, he would manage. He had maintained a "*good relation*" with all teachers. He seemed helpful in many cases. He was popular with his nickname 'Ambassador' among our friends.

"*If Maths Sir shouts at me, do you save me? I am not as clever as you, Mr. Ambassado*r?" I replied.

"*Of course! Binod. Let's go to play. I'll talk with the teacher*." Mr. Ambassador said. Hurry!

We went to the ground and joined the volleyball team. We forgot that we were going to appear in the SLC exam this year. We enjoyed playing volleyball.

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Our mathematics teacher was very laborious. He tried to solve many tricky problems in the class and encouraged us to solve easy problems as homework. The course was completed. We had still two more months for the SLC exam.

"*I make a model set of questionnaire for the SLC. All of you need to prepare for this. Let us take a mock exam and I will give you feedback on your answer sheets.*" Our Maths Sir said.

"Yes! I will secure distinction marks. Monday, Tuesday, Wednesday, Thursday! I have four days to prepare. The mock exam is on Friday. I think I can revise all the tricky questions and memorize difficult problems with the process." I silently committed myself.

I solved hundreds of problems day and night. I memorized all the formulas. I remembered many tricks of the problems that were mentioned important by the teacher. I could not practice harder trigonometric identity due to the limited time. I did not expect questions from the harder trigonometric identities.

On the next day, I went to school. We - fifty percentages of the students – were present there. I got shocked. Why were half of the students absent? Weren't they informed? The teacher entered the classroom. He angrily said, "*Those who are not present today for the mock examination, they will suffer later.*" He distributed the answer sheets and question paper. We took the test. The exam was over. On the next day, we had sports day. All of us were present there.

Who appeared in the mock test yesterday? I think they will get distinction marks in the SLC now? Mr. Ambassador satirically spoke with us in the playground. One of our friends asked, "*Why didn't you come to attend yesterday's mock test. It was a good experience*."

"I do not need experience. I do not have time to attend in such silly tests. I take only two exams before I go to my college – Send up and SLC. It is not necessary to make teachers happy now. They do not have anything in their hand," Mr. Ambassador

confidently spoke. The games were about to begin. The dismissal of our chats took place with the bell that indicated the beginning of the games.

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I now look back at those incidents. Why is the SLC examination given much importance than any other exams? Thousands of students appear in the examination of schools and colleges every year. I do not remember any stances that my relatives asked me about my exams and results before the SLC. My parents rarely knew about my exam schedules when I was a student in the university. Nobody cares when the university result publishes. Why did not our friends appear in the examination? Why did not they do homework regularly? Why did not we listen to our teachers? Why many of us remained absent intentionally in the mock exam? What sort of psychology did we develop as a student?

If we see the history of SLC exam, it started in 1990. It is taken as the national exam taken at the end of tenth grade of schooling. Although SSRP (2009) envisaged conducting a national level exam at the end of twelfth year, it has not been implemented yet. The government prepares questions in a central level and conducts exams on the same day nationwide. In the recent years, the government has decentralized question preparation tasks (for the core subjects) to five development regions. Though the questions are different for different development region, the practices of conducting exam, checking answer sheets and publishing result are governed centrally. I am here interested in delimiting the scope of this study to centrally controlled evaluation system rather than curriculum, pedagogy and the nature of mathematics. I discussed the nature of mathematics, pedagogical aspect and curriculum of such “standardized test” in the previous chapters.

In the initial days of my teaching, I used to convince myself on the usefulness of such exam in the name of standardized test. My deep- seated beliefs towards national board exam were so strong. When I reflect on those moments as I narrated above, many questions arise in my mind. Is it good to isolate students from social functions in the name of preparation for the SLC exam? Meier (2000) discussed that assessment should be a natural part of the developmental process within classrooms, children's learning being most influenced by ongoing and continuous assessment practices. Why did we not practice evaluation of students in a natural setting? This was the first time I left house for a week to sit in the examination. The district education office declared the exam centre before a month and we had hard time to manage our stay at that place. Police would check our whole body before we entered the examination hall as if we were lawbreakers. It was the notable time I went through terrible fear.

The next issue I want to highlight here is that the students' conception regarding teachers and schools when they reach grade ten. When students know that schools and teachers do not have any roles on deciding exam centre, preparing questions and checking answer sheets, students un/knowingly start to ignore schools and teachers as I narrated above. Many of us started not to complete homework and remained absent in the mock examinations in grade ten. In case of mathematics, the present evaluation system demands regular practices of the problems and frequent appearance in the mock tests. The roles of teachers and students are determined according to the existing evaluation system. Blomeke and Kaiser (2015) stated that teachers and final examinations expect pupils to be proficient in the application of rules and formulae and that it is the responsibility of the teacher as the master of the content to deliver these. For this, students should continuously engage in

mathematical problem solving. Continuous interaction helps students gradually form new identities and the development goes through a step-wise trajectory (Rennigner, 2009). In the lower grades, we used to have frequent interaction with teachers. But, in the secondary level, the interaction level had been dramatically lowered. I think all those were due to the name of standardized test. But, Brookhart (2009) mentioned that classroom assessment such as informal observation and asking questions are important at all grade levels. The standardized test discourages informal observation and classroom assessment.

I am here not only arguing against the national standard test, I have seen the limitations of school-based and teacher-based evaluation, too. We had to attend the send up examination before the SLC. All of us were declared 'successful' in the send up examination. There was a tradition of declaring all students as successful candidates for the SLC examination. If any students failed in this test, the parents would come to put pressure (in an unusual way) on teachers and school to make the students pass. People might take help of such incidents to undervalue the importance of teacher made tests. My argument here is to empower schools in the local level to practice authentic tests.

Sir, Where is the Pass Marks in the Question Paper?

I was appointed as a mathematics teacher for the secondary level after I graduated Bachelor's degree. This was one of the renowned schools of the district. The school's name was "Top International Boarding School". I had a tag of "College Topper" and I was well known as a teacher with lots of tips, tricks and techniques to teach mathematics (see Chapter V).

It could be any day in January, 2004. We all teachers were gossiping in the staff room. As usual, the matter of discussion was on the possibilities of next Prime

Minister of the country, nature of political leaders, and recently released movies. I was newly appointed at that school. Though I had deep interest in all those things, I hardly spoke on such issues; may be because I was a new teacher. The disorganized discussion was going on. The school principal unexpectedly came to the staff room. "*Good afternoon sir*". Everybody greeted him. The blazing discussion took shift into pin-drop silence.

"*There will be class test from the day after tomorrow. Please prepare a set of model questions of your subject by tomorrow.*" The Principal with orderly voice broke silence of the room.

"*Okay Sir.*" Everybody mutely accepted his order.

The Principal left the room.

"How is our principal? He could have been informed us at least a few days before. How can I prepare the questions for all grades by tomorrow?" A talkative madam angrily blurted out.

"*Agadi Muso Pachhadi Bhagha*"(literarry: Like a tiger at distance, but a mouse when closer),a teacher satirically responded.

"*Budesh kal ma na ghar ko na ghat ko hunu cha ra mukha mukhai lagera*"(Literally, by being mouthed, am I to be neither of home nor of woods in the old age?) Madam replied with her constraints.

"*I do not have time for official work at home. I copy some questions from textbooks now*." One teacher opened his drawer to look for a textbook.

The bell rang. Teachers went to the classes. I was lucky that day. I was at leisure for two consecutive periods. I also started to prepare the questions.

On the next day, I went to the Principal's room to submit my hand-written questions. I did not see the Principal in office. I handed the question over to the office attendant. After some hours, the office attendant came to my class. I was teaching grade eight students.

"*Excuse me; Principal Sir wants to meet you now. Please come.*" The office attendant said.

I went to the office room. "*Sir, why did you make multiple choice questions (MCQ) and project work for grade nine students? We need to make standard questions for grade nine as per the model of SLC*." The Principal denied my question.

"*Sir, I know model questions for the SLC. This is for class test. The purpose of this test is to investigate students' understanding in particular mathematical knowledge and problem solving skills. So, I did not follow the structure of the SLC. On the other hand, the multiple choice questions help me to identify students' strengths and misconceptions. I have wisely prepared possible responses of the question. Once I get all the answer sheets, I go for item analysis that can suggest for effective teaching. One of the purposes of secondary level education is to develop creative citizen. For that, project work in mathematics helps a lot."* I presented my logics believing that he would be convinced.

"*Our main purpose is to make them prepare for the SLC exam. If MCQ and project works are not asked in the SLC, why should you ask here?"* The principal disagreed with my idea.

I thought he was not asking new questions. I had already responded to his queries. Perhaps, I could not respond well. He seemed unconvinced. I remained silent.

"*I think you forgot to mention pass marks in your question?*" The principal put another concern.

"Sir, I did not forget it. I did not mention pass marks intentionally. This is a class test and I have already told you its purpose. We are not going to declare as failure or success from this test. The full mark is 25 in this test. If a student secures 20 marks out of 25, s/he will see the mistakes they made, and learn those things again. The same case is for other students who secure just 5 marks or below. Why should we declare pass or failure in class test?" I confidently put forward my logic.

"*You are so young. Please, do not be more revolutionary. We should not send out such questions in the market. People will criticize us. Revise and submit it tomorrow.*" The Principal demanded and made himself busy in checking the teachers' attendance register with a red pen. I thought it was no good speaking then since it was useless. So I went back to grade eight. The class time was about to be over. I was just waiting for the bell to go.

In the evening, my mind was busy recalling the conversations between me and the Principal. I was a student of education. I had learnt something on evaluation strategies and its different purpose. I was sure that I was not wrong. I was trying to practice something different. Why did the Principal not understand that? Why was I not able to convince him? Perhaps, I was wrong. No, I was not wrong. Perhaps, I could not convince him or/and he was not ready to change his deep-seated beliefs.

"Experts" Prepare Questions!

It could be any day in December, 2004. I was teaching in "*Top International Boarding School*". As instructed by the school Principal, I completed the courses of grade ten in rush. There were still three months remaining for the SLC examination to be held. I was informed to revise all the lessons from examination point of view and conduct mock examination every week. One day, when I was copying some questions from recently published well known practice book on the blackboard in grade ten, a

student from grade nine knocked at the door and said, “Maths sir, Principal Sir is calling you in his office.”

I immediately stopped writing the questions. I went to the Principal’s room. A well-dressed person was sitting on a chair near the Principal’s desk. “*Binod Sir, please introduce each other.*” The principal pointed at the gentleman. “*I am Mr. Educational Expert. I am from Mathematics background. I have been working as a school supervisor for more than a decade.*” The gentleman introduced himself. “*This is me, Binod. I am a Mathematics teacher here*”. I introduced myself briefly. “*Binod Sir, he is a government officer. He is involved in setting the SLC questions, too. He is a well-known teacher trainer. I requested him to prepare some sets of questions of grade ten for mock examinations. I have requested him to correct answer sheets of our students. I hope his feedback on the answer sheets will help our students to secure high marks*.” The principal introduced the guest and his intention.

“*It’s okay, sir.*” I maintained the minimum formality. The gentleman was sitting quietly. I was not feeling comfortable. I had been doing my best to make students prepare for the SLC examination. Why do we need external persons to prepare questions and check answer sheets? Am I not capable of doing these things? Why doesn’t my Principal trust me?

Perhaps, the Principal noticed my dissatisfaction in my face. He added, “*I am not asking him to do these things due to your deficit. You are doing your best. But, he is an expert. Let us take experts’ help to make our students more competent.”*

“*It’s okay for me*,” I reply with my fake smile.

“*He has given me a set of questions for three hours. Please inform students to be ready from 8 am to 11 am for a mock test tomorrow. They will have regular class*

after 11," the Principal declared. I left the room with his declaration. I went back to grade ten. I passed the Principal's notice. Everybody seemed frightened.

Next day, I reached school at 8 am. The Principal had already reached with the question papers. I distributed answer sheets and the Principal distributed the question papers. He gave me a set of question. I went through each question. Surprisingly, all the questions were asked from the same practice book that we had been using. The exam was over. The Principal took all the answer sheets.

I had mindful of questions. Why did my Principal give him to prepare questions? The 'Expert' is not teaching mathematics for many years. Perhaps, he cannot prepare questions himself. Why did he copy all the questions from the same book? Why didn't my Principal believe in me? Why did the Principal come to school to conduct the test? Why didn't he give me the question papers before the test? Can the expert be more responsible than me while correcting the answer sheets?

It made me annoyed, too. At this instant, I thought I needed to talk to the Principal. Later, I convinced myself that Mr. Principal would not listen to me because this was not the first incident I was planning to complain to him. Few months back also, I could not convince him about the question pattern I prepared. He was still not convinced with MCQ for grade nine and the question paper without pass marks. This was another unforgettable event for me with that Principal. I had a habit of writing memoir occasionally if I felt that the day was something different.

That day, I wrote a letter to my Principal as memoir. "*If I become a public figure in future, I will publish it.*" This thought came to my mind and I smiled alone at my idea.

The content of the letter looked like this.

Dear Principal

Namaste

I feel proud to be a teacher in such a renowned private school. I am enjoying a lot with my students as a secondary level teacher. Perhaps you know that I am also a student preparing for the final year exam of B Ed in Mathematics Education. Being a student of Education faculty and believing myself as a motivated teacher, I always think for better approaches in teaching and learning field. The activities (such as mathematics quiz, debates in mathematical ideas, preparation of wall paper on Mathematical facts and formulas) I am conducing in school are the reflection of my passion in teaching.

Last month, I submitted a question paper without pass marks. In the same question, I prepared some of the MCQs and questions for project work knowing that there will be no such questions in the SLC. You were not convinced with my ideas and I was compelled to change the questions as per your wish. I kept pass marks and replaced MCQs and project work by other questions derived from the "standard pattern". After a month, you hired an "expert" to prepare standard questions. You conducted exams and gave answer sheets to the same expert for correction. I know you are a very experienced school principal and people in the society believe that the school is producing excellent results due to your hard work and good leadership. I have some reservations about your beliefs. I think I am still right with the questions I prepared last time and I am not satisfied with your task of haring an expert for question preparation. I know you do not have time to listen such of my idiotic ideas. So, I am writing this letter. Perhaps, you do not find time to reply. Please read this letter carefully and give some time to reflect on your thoughts. I am sure it will be fruitful for you as a school principal.

At first, I want to share my thoughts on not writing pass marks in the question paper of class test. You may think that why I am wasting my time to justify such silly work. For me, it is an important issue to be discussed. First of all, we need to be clear with the purpose of the tests. For me, the purpose of the class tests is not to declare students as success or failure. The purpose of such class tests is to identify the strengths and weaknesses of students (also of teachers) for the remedial action. I see in every test the students make noise discussing whether they get pass marks or not. For me, our discussion should be based on the diagnosis of students' learning difficulties and readjusting the teaching and learning activities. Although there are multiple purposes of evaluation, I think many of us (including you) have deep-seated beliefs that evaluation is for the declaration of success or failure.

According to Gordon and Browne (2011, as cited in Asare, 2015) anyone involved in evaluation should avoid: unfair comparison, bias, overemphasis on norms, interpretation, too narrow of a perspective, and too wide of a range (p. 114). Why are we focusing more on norms? In a way, the norms can be useful. But is it necessary while conducting class tests? Is the purpose of all tests the same? Are we making students pass or fail after each test? Now, I want to draw your attention to two types of widely discussed evaluation practices.

Michael Scriven used the terms formative and summative evaluation in 1967. He distinguished them in terms of their purposes. Formative evaluation is done to improve practices and summative evaluation is for certification. Later, Benjamin Bloom also used this term in 1968 in his book Learning for Mastery. He used the term formative assessment as a tool for improving the teaching-learning process for students.

Dear Principal, I used the class test as a tool for formative assessment. In such a case, why do I need to write full marks? Harlen and James (1997) also advocate that formative assessment is essentially positive in intent and it is directed towards promoting learning; it is therefore a part of teaching. The second issue I want to raise here is that the formation of Multiple Choice Question (MCQ) and project work for grade nine students. Though I tried to convince you that day, I could not. Perhaps, you did not want to entertain the ideas beyond your routine task. Actually, you should know that I did not make such questions being unaware of the SLC model questions. I partially agree with your ideas of making grade nine students prepare for the SLC. The purpose of making MCQ questions was to identify their misconceptions in mathematics and manage remedial classes accordingly.

According to Houssart and Weller (1999), there are several inter-related aspects here with the first, recognizing common and misconceptions, being apparently the most straight-forward (p. 47). I want to give you one basic example of how MCQ questions are helpful to understand students' common errors and misconceptions. If many student choose the correct answer as $\frac{2}{4}$ for the expression $\frac{1}{2} + \frac{1}{2}$, we, as teachers, should identify the reasons that students apply to get this as their correct option. This is also one of the approaches of formative evaluation, which is a crucial tool for simultaneously improving classroom practice and students' performance (Petit, 2011).

You were taken aback when I planned to give Project Work for grade nine students. Yes, I know students will not be evaluated through project work in the SLC. But one of the national goals of secondary level mathematics is to prepare logical and creative citizens. I think our duty is not only to train students to secure high marks in

the SLC; we can/should develop lots of mathematical and social skills which are essential to solve daily-life problems.

You might have heard Gardner's (1983) multiple intelligences theory which has an impact on education around the world. The eight major intelligences (logical-mathematical, linguistic, visual-spatial, bodily-kinesthetic, musical, interpersonal, intrapersonal, and naturalist) have been shaping the curriculum, pedagogy and assessment in many ways over the last few decades. It seems that our evaluation practices are favorable for those students who have linguistic intelligence, and sometimes favorable for those having logical-mathematical intelligence. What about other students? Dear Sir, we sometimes gossip in the meeting that many students are very weak in studies but they are good in managing events and playing games. That means they have interpersonal and bodily-kinesthetic skills.

In some countries (such as Finland, Korea), students are being taught and being evaluated according to their interest and intelligences. In such context, why can't we introduce non-routine evaluation approaches? Luitel (2009) explicitly discussed the uni-dimensional notion of evaluation as the measurement of student performance in Nepalese mathematics classes. I wonder such practices may remain for many years if our school (taken as a successful school) also denies taking a shift from uni-dimensional notion of evaluation to multi-dimensional notion.

Now, I want to request you to recall a day when you hired an expert to prepare questions. I did not know whether you noticed my face. It was the day when I felt discouraged and disempowered in your school. I have some questions regarding the notion of Expert? How can government officer be an expert in making question paper and correcting answer sheets? I agree that he might have prepared questions papers for the SLC exam and might have corrected answer sheets. I think he has involved in

such activities being an officer of District Education Office. My argument here is that he is not a teacher. He has not been dealing with students for many years. In such a case, he cannot be an authentic person to prepare questions. I believe authenticity does not reside in post. Experiences might count. On the other hand, he copied all the questions from the practice book. There is no any question that he prepared. In such a case, how can he be an experienced person and expert?

Respected Principal, I respect your effort for making your school as one of the best schools by producing good results in the national examinations in this area. But there are many issues that need serious attention and revision is essential. If we do not entertain with the emerging evaluation techniques, our 'outstanding kids' in schools may be failure in their daily lives.

Best Wishes

Binod

This is Your First Day: We Do Not Evaluate You! We Assess You!

I was sitting in a chair in the waiting lobby. I was completely new with the people around, with the surroundings, and with the institution itself which I had just joined as a student.

"*Hello, are you a newly admitted student*?" One tall person, who had interviewed me, asked me.

"*Yes Sir*" I innocently responded.

"*Which department do you belong*? He further inquired.

"*Sir, I belong to Mathematics Education*" I replied.

"*The class begins at 4:30. We have 15 minutes time. Please, be there in room number one hundred and one. See you there*." He informed me.

"*Okay, Sir*." I sincerely stood and agreed with him bowing my head.

This was my first day at New Age University. It could be any day in February, 2006. I was there with lots of hope and commitment. I decided to make that a turning point in my academic journey. I went to the classroom before five minutes. There were some people sitting on the chairs, and two persons seemed to be preparing something at the front. Out of those two persons, one was the same person who talked to me in the lobby. I took a seat on the third row. I was ready with a copy and pen to note down the things that the tall man would probably say.

"*From the first day, I will make notes and prepare all the lessons at home. I do my best in the tests and try to be topper in this university."* I committed myself.

Slowly, more students got into the classroom and it was full.

"*Good afternoon, all of you. How are you today? We would like to welcome you in the program M Ed in Mathematics Education in this university*." The same tall person broke the silence of the room.

Another person was with some colorful markers and chart papers standing on the side of the classroom.

"*I am Mr. Mathematics Educator. I look after this program. I would like to share some of the features of this program*." The tall person introduced himself.

He joined his laptop with the projector and began his sharing.

He shared many things regarding mathematics education, teaching and learning issues, his experiences as a student and teacher, features of the program, possible ways of classroom teaching and assessment strategies. He spent almost half an hour in this sharing session. The one sentence he spoke was heart-touching for me.

"*This is your first day in the university. We begin to assess your performance from the day one. Your assessment begins now*." He said regarding the evaluation system in this university.

After a noticeable pause, he added, "*we do not evaluate your achievement. We assess your performance."*

"*Oh my god! How is it possible? We have not received curriculum; there are no any textbooks available till now; we have not discussed any content yet. This is just a first day in the university. How can we be evaluated? What are the bases of evaluation?*"

A dozen of questions emerged in my mind.

Till the day, I had understood that the notion of evaluation and assessment was the same. But the facilitator's intention of assessing our performances rather than evaluating our achievement challenged my understanding.

"*Sir, we all are busy in our jobs. We cannot be full time students. We need to earn to survive. So, please give us few assignments*." A fat and tall boy said with high confidence as he was familiar with the teachers and the system. Later, I came to know that he had completed the Post Graduate Diploma in Education (PGDE) program from the same university and both of the teachers were familiar with him.

"*Sir, I do not understand what assignments are and how do you evaluate our achievement. I am from Classical Academic University. I passed previous degree appearing in the written examination at the end of each year. I am here with great hope and commitment. Perhaps many of us do believe the same*." One young student spoke. The body language of some students showed that he was trying to capture others' voices too. I wanted to speak the same. I thought he spoke my heart out.

"*My dear, we are here to facilitate you. We are not here just to measure your achievement. We are here to optimize your performance. For this, we continually help you. To respond previous friend's curiosity, we give you necessary assignment. It is neither less nor more. Please develop learning attitude. Do not be fearful about grades*." Mr. Mathematics Educator tried to sympathize us.

But, I was yet not convinced with the version of Mr. Mathematics Educator. I was expecting some clear-cut outlines for the evaluation so that I could prepare for the better result from day one.

The teacher distributed a sheet of paper. It was the course plan of the subject "Teaching Mathematics 9-12." I quickly scanned the plan. My eyes paused at the assessment strategies which could be summarized as follows.

In-semester Assessment (50%)

Five reflective Journals (5 times 10= 50)

One presentation (1 times 10 = 10)

One long paper (1 times 20 = 20)

Attendance and classroom participation (10)

One class test (10)

End Semester Assessment (50%)

I was shocked with the assessment policy. That was the first time I heard reflective journals. What are they? What shall I do with them? Are they for writing or something else? I had never presented in front of my class and teacher. In addition to that, I was informed that the medium of instruction would be English. I could not simply imagine presenting entirely in English. What does classroom participation mean? How do we measure it? How does a teacher decide one has participated well and the other has not? Oh my god! How can I pass in such subject that requires more language and interpretation? Did I make a correct decision to join this university? I was confused. So many questions were hovering over my head.

"*Perhaps you all have gone through this plan. This is our tentative plan. We may change later in the contents and assessment strategies in the course of time if we think the changes are necessary."* The other person spoke for the first time in the

class. He was the co-facilitator in the class. The version of co-facilitator added more confusion. How is it a tentative plan? Aren't there a fixed course details decided by the university? Can the contents and assessment strategies be modified? If it is so, what is the authenticity of the course? Can the teachers revise the course plan during the semester?

"I can read your faces. You are in confusion today. The things will be clear in days to come. Let us not waste our time discussing the course plan and others issues regarding the course. Let us begin discussion in our lesson." Mr. Co-facilitator brought a turn in the classroom scenario.

He distributed a chart paper for each group of three students. He gave a few colorful markers to each group. He then asked us to write how teachers had been teaching mathematics in the school level and how mathematics had to be taught. Both the facilitators persistently encouraged us to discuss in the group and come up with ideas. After the discussion in group, each group selected one representative from the group, and the representative shared the collective ideas in front of the class. It was really fun! Some groups came up with life stories of teaching approaches of mathematics and some group envisaged effective strategies for teaching mathematics. After sharing by the group representatives, Mr. Mathematics Educator made a presentation on "*Teaching Mathematics: Past, Present and Future*". His presentation was fantastic for me though I did not understand some of the terminologies he used. The discussion went well. The allocated time was about to finish.

Mr. Co-facilitator said, *"We have carefully watched your participation in discussion, your motivation while sharing ideas and your curiosity when your friends are sharing their thoughts. It is amazing. This is how we continually assess you."*

"Now, we give you a task for today. The task is – how do you reflect your first class at this university? What were your expectations of the course? What did you learn from the class? What things did you like and what things need improvement?
This is your first journal (assignment). We go through your writing, provide comments, and give opportunity to revise. Do not hesitate to write. Write those things that come in your mind regarding the questions we provided to you." Mr. Mathematics Educator assigned a big job on the first day. This was how we received an assignment as a part of assessment. Perhaps, it was one of the days when my mind was full of questions.

Questions Are Out! You Have One Week to Answer Them!

It could be any day in April, 2007. I was a student of Master's third semester. We were habituated with the teaching approaches and the assessment practices. Though all the facilitators did not follow the same assessment strategies, they were somehow similar in many cases - underlying on the principle that assessment is a continuous process and an inseparable part of learning. Lately, I realized that our facilitators provided assignments to develop continuous and self-learning attitudes. The purpose of assignments was not just to evaluate us.

One of the courses in the third semester was "Curriculum and Evaluation issues in Mathematics". It was the first day of the course. The facilitator was not new for us. "*Sir, please give us less assignment in this course. There are many courses including pure mathematics in this semester."* One of our friends fearlessly spoke before the facilitator oriented us about the course. The facilitator just did that adorable half smile as usual and began the orientation in the course plan with the help of PowerPoint slides. It seemed that all of us were waiting for the last portion of the plan, where we would usually get the assessment policies. I put my big eyes onto the

slide with the title Assessment. Many criteria were similar to the previous courses. But, my eyes stopped at the last line of the slide. There it was: End semester assessment - Take Home Exam.

"*Sir, what does this 'take home exam' mean?"* I immediately put my query. Many of our friends were with me with the same query.

"*I will provide few questions at the end of this course. You need to respond them. You can consult books, papers, internet and any other resource materials that are available. You need to submit within one week. There will be no close written test in this course."* The facilitator explained to us the notion of take home exam.

Hurray! Thank god! There is no three hours written test. We should not make notes of lectures and perhaps sophisticated theories on curriculum and evaluation and memorize them for the exam. We are now good at googling. We can easily respond to the questions our facilitator provided to us for take home exam. We decided to celebrate this plan with delicious food at the university canteen at that day.

The semester went well. We were trying to maintain the deadline for the in-semester assignments. At the end of the second last class, the facilitator provided us with the questions for take home exam. All individuals received separate question. I read my question. There was only one question. But the question almost covered the entire page. In the beginning, I thought how lengthy it was. The task itself was multifaceted, and some portions of the task looked like this.

…Examine the interrelation of various dimensions or domains of curriculum – theoretical, practical, and critical. In what ways do the curricular domains are reflected in different curriculum models? Do you think there is an association between curriculum dimensions/domains with different models of curriculum? Why? Write your journal based on your reflective/reflexive thinking about three

domains/dimensions of curriculum in general and mathematics education in particular.

…How do you envisage yourself as an ideal curriculum developer? In responding to this task you may refer to specific views about different facets of mathematics curriculum that you possibly developed during this course work. Such facets may be considered as, but not limited to, perennial mathematics curricula, critical mathematics curriculum, humanistic mathematics curricula, integrated mathematics curricula. How do you expect to apply those facets in our school level mathematics curriculum? …

When I read the question, I remembered the first day when we celebrated the idea of take home exam. How painful the question was. I was speechless. I looked around expecting my friends' comments on the nature of the questions. Many of our friends were reading the questions patiently keeping their hands on head.

"Are you asking us to respond to this question or expecting us to write a book, sir? This is a very challenging task. The closed written test would be easier than this." One of our friends broke the patience of the whole class. We all laughed looking at each other. We were running out of time. It was being late especially for those who used public vehicles.

"Sir, we don't get public vehicles if we do late. We have already crossed fifteen more minutes than our usual time." One of our students requested to end the class for that day.

"*It's okay! I will write an e-mail regarding the nature of question, and my expectation. See you later.*" The facilitator concluded the session.

Now, I act as a researcher. I want to reflect back on the moments I had particular beliefs on evaluation, the moments I was in great dilemma with the

changing scenario, the moments Mr. Mathematics Educator and Mr. Co-facilitator tried their best to apply "*off-track*" assessment system. I used to take myself as a good practitioner of emerging approaches of evaluation. I celebrated my practices of formative evaluation as discussed in the previous narratives. The use of various tools (MCQs, projects, practices, mathematical quiz) in evaluating students' achievement for the improvement of teaching and learning was my long held belief and also the practice of evaluation. The first day at New Age University challenged my deep-seated beliefs and practices on evaluation. I have been using the notion of evaluation and assessment interchangeably. Later, I spent sufficient time and effort to know the differences between assessment and evaluation.

Is it Evaluation or/and Assessment?

The practices of sitting in several test items to decide success or failure has deeply developed my understanding solely on evaluation. Although I was a bit familiar with the notion of summative and formative evaluation in the undergraduate level, my limited understanding did not allow me to welcome the notion of assessment wholeheartedly. I tried to understand the notion of assessment inside the notion of evaluation in the beginning days at New Age University. Assessment has usually been used to indicate that at least some hints of improvement are expected in the assessment process (Bordon & Owens, 2001 as cited in Baehr, 2005), whereas evaluation is usually used to indicate some sort of judgment of quality of the works or products.

Later, I myself internalized the notion of evaluation as the comparison of what is measured against some defined criteria and determination of whether it has been achieved, whether it is appropriate, whether it is good, whether it is reasonable, whether it is valid and so forth. This may be useful in some contexts. But the entire

school education system should not be guided by such narrowly conceived notion of evaluation. I think one the reasons for the majority of school aged children being outside the schools is due to this widely practiced one-size-fits-all approach in evaluation. Luitel and Taylor (2005) stated that using only sit-for-test exams as a means of assessment afford extreme authority to a selected group/person. Such an assessment system empowers the powerful and overpowers the powerless (p. 7). "*This is the assignment you sent via e-mail. You have discussed wisely. But you also need to argue why it is so*?" The facilitator frequently gave me feedback on my work at New Age University. I used to worry about my grades in the beginning, perhaps my facilitators were busy on gathering my data, strengths and limitations to make myself better in days to come. National Curriculum Framework for School Education in Nepal (2007) defined that the assessment is a process of gathering, interpreting, recording and analyzing data, using information and obtaining feedbacks for re-planning educational program (p. 26).

The ontology of such evaluation system is celebrating the reductionist view of knowledge as necessary assertions arising exclusively from evidences collected from an '*out there'* field (Luitel, 2009). We have been groomed with the Euclidian Geometry as only the basis for entire geometrical system. I lately realized that the overemphasis on Euclidean Geometry in schools has been disempowering me to open up various important and useful fields of geometry (such as Projective Geometry, Hyperbolic Geometry, etc.). More than this, the firmly rooted Euclidean paradigm (space as taken as a measurable and rational system) has a great influence on the evaluation system as well in which everything is assumed to be measurable in a plain way and that can be generalized. Later, I came to realize that New Age University is

using the evaluation system as grooming of students rather than certifying the failure/success.

Do We Measure Achievement or/and Assess Performance?

The intention of any job is very important rather than the task itself, I believe. The purpose of evaluation in Nepali schools is largely based on measuring their achievment in a more tangible way.

"What number did you get in this subject?" "What is your percentage in the final exam?" These are the frequnently asked questions to the Nepali students. The national newspapaers are found to be covered with the photographs of the students with their percentages when they pass in the national examination such as SLC and Higher Secodary Education Borad (HSEB). Schools and colleges are being awarded as the best schools on the basis of their students' achievement. The achievement is here discussed in terms of the grades achieved by the students. Ritchie and Bates (2013) argued thatachievement is the determination of a student's academic competencies in related content areas. The overemphasis on scores and the narrowly conceived notion of achievement is being problematic in Nepali school education in general and in mathematics subject in particular.

The classes I took at New Age University opened my eyes beyond the formative and summative evaluation. Indeed, I was being assessed throughout the semester and the purpose of assessing us was to identify our strengths and limitations so that the remedies can be planned accordingly. One of the remarkable activities that led me towards preparing journaling task was providing feedback on a regular basis. My intention, in the beginning days at the university, was to get good grades. I was habituated to scroll-down the screen of my desktop computer quickly expecting to see the good grade at the end of my journaling task. After seeing my grades, I would

slowly to see the feedback provided by the course facilitators in almost all the paragraphs of my writing. Later, I realized that the regular feedback gradually helped me to improve my writing skills and indeed prepared towards the practitioners in research field as, very much akin to what Banerjee (2014) found in her research study - the teachers' feedback is one of the key turning points in effecting students' learning (p.1).

I found feedback to be very useful for me to improve my performance. The ideas of Wiliam (2011), feedback functions formatively only if information fed back to the learner is used by the learner to improve performance, is very timely to remember here, When I was involved in various training sessions during this time, I heard the concepts of Continuous

I Know CAS!
My school provides me paper-sheets
There are many pages to list
I take out the sheets once a month
Fill it without taking students' concern
I know the CAS!
***
The school supervisor asks to fill CAS form in every class
Keep the record of each individual in every task
There are fifty students in my every class
May I list all the behaviors of the students or put tick marks at last?
I know the CAS!
***
I took many trainings on CAS last year
It is good listening about many forms of students' care
Can you please give me three periods a day?
With 20-25 students in a class where I can talk with each of them
I know how to use CAS!

Assessment System (CAS). The idea of CAS was very much closer to what my university teachers were applying in various courses of mathematics education. *"How pleasant it would be if we could apply it in our school education?*" I started to think. I immediately searched the practices of CAS in various countries. Surprisingly, Nepal has already started the practice of C AS in the school level. In Nepal, Primary School Curriculum (2063) has mentioned that CAS is focused in classes 1-3 to facilitate student's learning and document the changes they have demonstrated. Similarly, school, can also adopt other tools of evaluation according to their needs.

When I was a student in the secondary level (1996-97), the government had piloted CAS in five districts - one district from each development region. Gradually, Nepal government extended the practices of CAS in upper grades too. Now, grade four and five students have 50% weightage and grade six to eight students have 40% weightage for continuous assessment. I have a good reason to recall those incidents here. I was teaching in one of the popular private schools in the capital city of the town at that time, and I was not aware about CAS, when the government had already implemented it. The university classes not only encouraged me towards the continuous assessment system from the classroom practices, but also propelled me to search the government's provision and practices.

On the other hand, as a researcher, being out there, I have many reservations towards CAS used in both university and schools. The submission of the assignments at the last moment and receiving the final grades without any feedback was painful in some of the courses. The misuse of the rights given to the course facilitators (preparation of the course, delivering the classes, assessing students' performances, etc.) sometimes created problems. In the same manner, I saw many of the teachers are misusing the notion of CAS. Out of many reasons, the structured format of the

government and the bureaucratic-supervisory roles of school administration might have been disempowering teachers to apply this.

Assessment for Nurturing Creativity

I want to discuss one of the narratives I mentioned above: "Questions are out! You have one week to write answers". As stated above, we were feeling comfortable when there was a provision of take-home-exam. It was my first experience of such examination. Many of us seemed happy. But the happiness did not last long. The question for the take home exam diminished our happiness level, and the week we were given to respond the question was painful. Being an outsider, I am now recalling the moments with its intent. I still remember the Dean's speech at the time of orientation as post-graduate students. "One of the purposes of post-graduate program is to make you able to create something with some critical and creative lenses."

Almost all the course facilitators at New Age University encouraged us to write "reflective writing". 'Just write what you have understood, challenge your own previous thoughts and suspend your beliefs while writing' was the most frequent orientation given by our teachers when we asked them how to write classroom reflection. Later, I came to realize the importance of self-reflection, aligning the ideas of Ditchburn (2015), who stated creating opportunities for pre-service teachers (PSTs) to critically reflect on and theories about their practice is frequently regarded as an essential component of professional experience (p. 94). We, as teachers, have learnt many theories and attended several kinds of professional trainings. But when I go to the classroom, I find the theories not working as I was expecting. In this context, Shulman (1987) discussed that the notion of orienting reflection as it is the process of transforming academic knowledge of teachers to pedagogic content knowledge. The developing of Pedagogical Content Knowledge is very challenging in the case where

many of us directly try to fit the theories developed in the Western Modern Worldview. Perhaps, Luitel (2009 & elsewhere) discusses the important of “small p philosophical inquiry” for teacher education research. The writing reflection was not limited as a means of assessing our performances but also helped us to become aware about our assumptions and beliefs, and gave spaces to visualize as better teachers and teacher educators. The research I carried out on my own stories made me recall what Van Mann (1991) wrote, “ The educational research needs to be based on “ textual reflection on the lived experience and practical actions of everyday life with the intent to increase one’s thoughtfulness and practical resourcefulness or tact” (p. 4).

The “Critical Reflection Writing” as a tool for assessing our performances was very useful to be a practical teacher in many ways. The one week time provided by the facilitator to respond to the questions for take home exam was not sufficient for me. It was really a challenging task, and indeed left great experiences to mould our critical thinking. Critical thinking is a complex mental process involving paying attention to details, selecting relevant information, analyzing carefully and skeptically, making judgments, and meta-cognitive thinking such as reflection and higher-order planning (Cottrell, 2011).

As a student of teacher education, Bloom’s taxonomy of cognitive development was not new for me. Benjamin Bloom in 1950 suggested a way to organize thinking skills into six levels, from the most basic (i.e. knowledge) to the more complex (i.e. evaluation) level of thinking. A former student of Bloom, Lorin Anderson, revisited the taxonomy in 1990. One of the major contributions of Anderson was to explicitly discuss the essence of the higher-order-thinking and keeping “Creating” as the highest level of cognitive act. Anderson and Krathwohl (2001) mentioned that metacognitive knowledge is one dimension of knowledge in

which a learner creates a product with one's own cognition with enough awareness. My intension to bring the ideas of revised Bloom's taxonomy here is to connect the assessment practices of New Age University. The purpose of my facilitator to provide take home exam might be guided by Bloom's revised taxonomy, aiming to develop critical and reactive mathematics educators.

My beliefs about assessment have dramatically changed over the period of time. The moments I spent at the university as a Master level student was the turning point in my journey of perceiving the notion of evaluation and assessment. Here, I am not presenting the practices at the university as a utopian. There were some shortfalls on the practices of assessing students in terms of consistency of the tasks, providing timey feedback and assigning the grades. In spite of these limitations, the adaptation of comparatively new assessment practices opened my eyes and mind in many ways.

How Does She Survive With Grades Only? Where Are Projects And Practical?

It could be any day in April 2012. I was sitting in the staff room with some of my colleagues. It was my off period. Oh! Many of us were enjoying the off period. Some of us were busy with newspapers, some were engaged with gadgets, and few were involved in copy correction. I was busy checking the features on the new i-phone another teacher had.

*"Binod sir, one of the parents is waiting for you in my room. He wants to talk with you regarding his daughters' progress."*The Program Coordinator disrupted my engrossment with the i-phone.

I walked to the Coordinator's room without any verbal response. The program coordinator also came with me. "*Sir, the parent seems highly educated. Please talk with him wisely.*" He made me aware in the corridor.

"*He is our Mathematics teacher and he is the parent of Miss Ranjana*." The Program Coordinator introduced both of us to each other pointing simultaneously.

I sat on a chair near the parent.

"*Sir, how is my daughter in Mathematics*?" He initiated the conversation.

"*She is okay. She secured good grade in the recent class test, too*." I began with a positive comment.

"*She showed her mark-sheet last week. The grade was above normal. But I asked her to show evidences of participating in projects, mathematics Olympiad, debates, quizzes, etc. But she did not reply*." The parent talked as if he knew all the activities we conducted.

"*Yes! She is active in the classroom too*." I intentionally twisted his concern.

"*I also did Cambridge GCE A-Level from India. I was very good at Maths at that time. I used to participate in various activities related to mathematics and science. The participation in such activities helped me a lot when I studied Economics in the university. I expect similar participation of my daughter*." His background made me speak sensibly.

"*Oh! It's good to have such a wise parent. We also organize such activities occasionally. But very few students seem interested to participate in mathematical activities. If we organize sports competition, drawing competitions, photography, singing, dancing, etc., we get enough participation. Last year, we conducted mathematics quiz. It was very difficult to get the participants*." I tried to blame students for their low participation.

It is noticeable that many students do not take mathematics as an appealing subject and more than that they think learning mathematics means just solving mathematical problems. What a parent he was. It was the first time I had talked with

such a parent who was dealing as a mathematics educator. I did not speak. I just bowed my head.

The room was full of silence for a while.

"*It's okay, sir. I came to pay the tuition fee. At this time, I am here to request you to encourage my daughter to participate in other activities too. I told her that you do not survive by mere grades now.*" The parent said.

"*I will surely do this. See you again.*" I stood.

"*Okay sir. See you.*" The parent left the room.

I was alone in the Coordinator's room. The conversation with the parent made me thoughtful. I was a post graduate student at New Age University. I was also facilitating the master level students in the courses of mathematics teaching, curricula and assessment. I frequently engaged my students in various mathematical activities to assess their performance. How much have I been practicing non-paper test where I have been engaged as a teacher? It was the time when I had just come back from South Korea participating in the 12th International Congress on Mathematics Education (ICME) where I actively participated in the seminar of Assessment in Mathematics Education. The mathematics course I took in Cambridge CGE A-Level also demanded various activities to assess students' mathematical abilities. What made me not to initiate such activities? Dozens of questions were dancing in my mind. The bell rang. I moved to the class with some markers and a textbook.

In the above narratives, I presented my beliefs and practices on the spectrum of assessment in mathematics class. The narrowly conceived notion of assessment has played a great role in my teaching career. The moment where I could not apply the comparatively newer forms of assessment although I was well known with those practices made me thoughtful to investigate my long-rooted beliefs and practices

towards assessment. Regarding the assessment practices in mathematics class, I am with Dayal and Lingam (2015), who advocates that it is time to challenge the traditional mindset of teachers seeing themselves and being seen as the controlling authority. The traditional, absolutist paradigm argues that knowledge can be awarded objectively and non-negotiable status (Burton, 1992). Under this paradigm, behavioristic perspectives of learning have dominated with a scientific, measurement view of assessment. The assessment practices are linked with the ways of classroom teaching. According to the traditional view, teaching becomes transmission of knowledge from the head of the teacher to the heads of the learners, very much akin with the explanation of Luitel (2009), where he argued Nepali mathematics classroom as being guided by "Banking Pedagogy". This view of teaching and learning as a transmission of knowledge often leads to a narrower view of assessment in which testing and examinations become the ultimate approach in themselves with the focus on reproducing knowledge and measurable skills to be demonstrated on a piece of paper. Frade, Acioly-Regnier and Jun (2013) have often discussed such form of assessment as the older form of assessment, which assumes that students' cognitive development can in fact be measured accurately using well-designed tests. I think the use of summative and formative assessment in our context that was discussed in the earlier narratives is also older form of assessment.

The other paradigm, generally referred to as the socio-constructivist one, views learning as a social process in which learners' interactions with their environment and the role of communication are seen important (Burton, 1992). In this view, assessment is viewed as socio-cultural activities. The learners are viewed as constructivist participants believing that each learner has special attributes, and assessment should identify such unique attribute for further enhancement in a regular

basis. Dayal and Lingam (2015) mentioned that such ways of understanding assessment implies an image in which instructions and assessment are indissolubly linked (p. 45). The notion of assessment we practiced at New Age University is similar to what Wyatt-Smith, Klenowski and Colbert (2014) mentioned – the conception of "assessment as enabling power", arguing that the role of teachers and school environment is essential for assessment to play an enabling role by providing regular and necessary support. The authors further believed the social and cultural capital that young people bring to the classroom and argued that teachers' role requires them to harness such capital in which the assessment should take beyond the grades and certification.

The socio-constructivist paradigm of learning and the appropriate assessment for such viewpoint is very challenging and non-linear. I think the successful use of such notion of assessment depends upon the teachers' interest and ability to carry on. As a researcher, I am not discussing here in favor of one and diminishing the role of the other among these two seemingly opposite views of assessment. I am aware of the Nepali context, and the challenges of using various assessment strategies. I have experienced and as mentioned by Luitel and Taylor (2010), Nepal turns a blind eye to traditional mathematical practices and associated social values enacted daily by local communities, thereby serving as a powerful means of one-way enculturation into a globalizing western worldview.

Chapter Summary

In this chapter, I unfolded my beliefs in and practices of assessment, especially in mathematics classes. I came to know that the first few narratives discussing my deeply-rooted beliefs and the practices on assessment were guided by the absolutist paradigm of learning. The objective ways of evaluating students' achievement took

wide spaces in my professional life. The moment I encountered with the alternative forms of assessment (i.e. socio-constructivist view) theoretically could not motivate me enough to take it down to earth. May be the unsupportive environment, unhelpful administration and dominating view of the “curriculum as subject matter” were the major external forces restraining me. More than that, I, as a teacher, was reluctant in some ways to practice such assessment strategies we practiced at New Age University.

CHAPTER VII

LOOKING BACK AND MOVING AHEAD

This chapter begins with a synopsis of how I culminated the research questions in this inquiry. I have portrayed my experiences of investigating the research questions via my own journey as a student, teacher, teacher educator and researcher. While unpacking those research questions, I tried to highlight the moments I realized adopting the multi-paradigmatic research design (Taylor, Taylor & Luitel, 2012) and writing as inquiry (Richardson, 2000). The use of various theories as referents and autoethnography as a research methodology are discussed in this chapter. The changes I gained during this inquiry, the moments of happiness and frustration in this journey and the possible implications of my narratives for other mathematics teachers and researchers are presented shortly.

Recapturing My Research Aims

I was one of the students who liked (and still like) school level mathematics very much among the majority of friends who did (do) not like it so much. While solving mathematical problems, the procedural approach and the axiomatic logics were very popular in mathematics classes. The ultimate goal was to get the correct answer. When I was promoted to the secondary level, the uses of tricks and techniques of solving the certain routine problems were very famous and I used to prove myself as a genius student remembering those techniques. The overemphasis of "pure" mathematical problems in schools shaped my belief *mathematics as a body of infallible knowledge.* My view towards mathematics was *mathematics is what mathematicians do and create.* The same view continued to occupy my mind for a

longer period in my professional experiences as a teacher from the primary level to the secondary level. During that period, the conception of research was to identify mathematical formula, investigate some theorems, prove some unsolved mathematical problems, etc. I was motivated to be a researcher by being engaged in such activities. At the same time, I was worried about how I could develop new formulae and prove theorems.

By the time, my engagement with some educational philosophies, theories in teaching and learning, educational psychology as a student of Bachelor in Education gave some insights of teaching and learning perspectives in mathematics. I also got an opportunity of conducting a research project in a group in one of the subjects during my Bachelor level study in 2004. The subject teacher orientated us with the research project within a few hours giving us strict chapter outlines – Introduction, Literature Review, Research Methodology, Data Analysis and Interpretation, Findings and Conclusion. The questions with fixed responses were the data collection tools. The descriptive statistics were used to analyze and interpret the data. Fortunately, we five were selected in a group, and we prepared that research work very easily dividing one chapter to each of us. The compilation of our discrete work was submitted as the research project. My long-seated belief towards *research as investigation of formulas and theorems* was converted into five-chapters. The very limited orientation on research project and its "successful completion" gave me courage to continue such works in future.

Paradigm War

When I joined Master of Philosophy (M Phil) in Mathematics Education, I got lots of opportunities to interact with various research traditions in education in general and in mathematics education in particular. At that time, the research issues I

prioritized were drastically revised. One of the vital instances that made me thoughtful about research traditions was my reading of the paper by Taylor and Medina (2011) on *Educational research paradigms: From positivism to pluralism*. I came to know that my belief towards educational research was guided by post/positivist paradigm. The construct "paradigm" has been explicitly discussed in the paper as a comprehensive belief system, world view, or framework that guides research and practice in a field (Willis, 2007). The convincing part of the paper was bountiful efforts to justify the essence and uses of each paradigm with sufficient examples under the distinct set of quality standards. "No research paradigm is superior, but each has a specific purpose in providing a distinct means of producing unique knowledge" (Taylor & Medina, 2011, p. 1).

I was a student of statistics, and very much interested in playing with numerical data. The collection of a large chunk of data, inserting them into some mathematical software, deriving tables and charts, testing various hypotheses, claiming single knowledge as the absolute truth and sharing the findings among scholars was very interesting trajectory as a researcher. I spent a lot of time going through such research projects and memorizing the findings as an ultimate truth. In many cases, I was guided by those findings as a classroom teacher, and teacher educator. In the initial days of teaching, I was not in the position to challenge the knowledge obtained from such research. Perhaps, the over trust in 'numerical data' has played a role to shape my beliefs. In the course of time, out of many journal articles written by great scholars, the article *The Death of Data* by Denzin in 2013 gave me lots of insights regarding the uses of data in research. He began the article with the sentence, "*Data died a long time ago, but few noticed*" (p. 1). Denzin (2013) writes, "the reader is asked to imagine a world without data, a world without method,

a world without hegemonic politics of evidences, a world where no one counts, a world with end" (p.1). During those times, my teacher at the university encouraged me to think out of the box. *Do not be slaves of particular theories and research paradigm. We are practitioners. We need to apply theories as referents, not as ultimate framework.* Our facilitator repeatedly suggested us. It helped me to come out of my narrowly conceived understanding of research traditions and the research issues in mathematics education. I was planning to study the beliefs of mathematics teachers towards the nature of mathematics, mathematics curricula, assessment and their pedagogical practices.

One of the major objectives of my research in its initial phase was to unpack how teachers' beliefs affect classroom teaching. For this, I chose ethnography as research methodology and started to develop a research proposal. During the time of materializing the research proposal, I encountered with various research studies (such as Belbase, 2006; Afonso, 2007; Cupan, 2008; Luitel, 2009) that made me thoughtful to (re)search my own professional stories, give sense of those events, critically assess assumptions and plan for better future. I thought my stories could be the best mirror to re/present the status of teachers' beliefs and practices on various dimensions of mathematics education. At that time, I had more than ten years of teaching experience in various educational institutions from the primary school to the university level. The beliefs I held regarding the nature of mathematics, teaching and learning activities, mathematics curricula, evaluation and assessment practices underwent a drastic change, and the practices I employed as a teacher and as a teacher educator have been shaped likewise. I believed that the examining of my personal-political and professional narratives would help to improve my own practices, and may be it would be a useful document for those who are working in the field of teaching and

researching in mathematics education. One of the purposes on this study therefore was to understand and reconstruct new meanings of my beliefs and practices on different facets of mathematics, and teaching and learning issues in mathematics.

Multiparadigmatic Research and Autoethnography

How can I choose the research under certain paradigm? How can we set paradigmatic considerations? These difficult questions always stoke my mind at the time of research proposal development. As I mentioned earlier, though Taylor and Median (2011) gave lots of insights into various research paradigms in educational context, I could not fit myself with a certain paradigm. Later, I read the paper *Multi-Paradigmatic Transformative Research as/for Teacher Education: An Integral Perspective*, written by Taylor et al. in 2012. This paper together with rich classroom discussion on the uses of various approaches in a single research helped me a lot to make sense of multi-paradigmatic research, and its uses for teacher educators. In doing so, the interaction with various forms of knowing became very fruitful for me, especially encouraging me to use multiple research paradigms in a single study.

As a student of mathematics, I was guided by the classical hypothetico-deductive logic of the postpositivist research paradigm, which comprises powerful but restrictive logics, namely, propositional, deductive and analytical at the beginning of my teaching career. Later, as a researcher, the alternative forms of logic played significant roles in my thinking. The alternative forms of logic, such as dialectical logic which allows the transformative researcher to hold contradictions together in creative tension (Luitel, 2009); metaphorical logic, which promotes open and embodied inquiry for exploring multiple facets of knowledge and knowing (Lakoff & Johnson 1999); narrative logic that enables transformative researchers to contextualize their knowledge claims within their personal, professional and cultural

contexts (Clandinin & Connelly, 2000) directed me to create spaces for using multiple paradigms in my study.

The interpretive paradigm provided opportunities to seek understanding and make sense of my own various professional narratives together with the perspectives of my contemporary teachers, school leaders and other stakeholders which were shaped by the philosophy of social constructions. Subjectivity is an integral aspect of such research. Through the interpretive paradigm, I observed a situation with different approaches to solving problems. A multiple number of possible solutions and interpretations also emanated as a teacher and teacher educator. Consequently, the function of epistemology in an interpretive paradigm was to acquire knowledge by investigating the phenomena in many ways, as the social context is different from natural science.

The paradigms of criticalism turned to be very fruitful in my study. It was employed for ideology critique to understand how power imbalances serve as key sources of social injustice within the normative social structures, especially in terms of reproducing habituated behaviors of teachers and students. It helps us to create emancipatory learning environments in which the students develop critical consciousness on their daily activities and become aware of the various governing forces behind such activities as mentioned by Taylor (2008); the critical paradigm promotes the notion of social justice in order to create the world which is “fairer, more equitable, more inclusive and more harmonious). I claim that the voices raised for changing the classroom teaching, assessment practices, curriculum (re)from using dialogical forms of writing have engaged the readers in reflecting critically on their own beliefs and assumptions on normative social values and practices. In doing so,

my readers may engage in pedagogical thoughtfulness as mentioned by van Manen (1991).

The use of postmodern paradigm in my research focused on the importance of self-reflections, envisioning, and lived experiences through personalized writing which might evoke researchers to express their thoughts and practices in an engaging manner. This paradigm employs arts-based research to engage, empower and envision readers as well as the researcher. At the beginning, I was overwhelmed by this research paradigm and tried to write poems, stories, and drama to capture the meaningful and relevant events for my study. But, I could not be able to produce as I was thinking. Yet, I think I have done justice to this paradigm aligning to what Denzin and Lincoln (2000) said – the postmodern paradigm allows individuals to include their personal responsibility, emotionality, and ethics of care, multi-voiced texts, and dialogues to know something without claiming to know everything. With the help of performative and non-linguistic genres, I tried to capture the narratives in a better form aiming to engage the readers with the orientated, strong, rich and deep textual representation.

It was not easy for me to preserve the epistemic integrity of research methods drawn from various paradigms. To maintain the epistemic integrity along with the purpose of my research, I employed critical autoethnography believing that it is one of the best methods for me. I have sensitized autoethnography as Ellis and Adam (2014) mentioned - autoethnography as research products, writing processes, storied texts, and methods that connect the autobiographical and personal to the cultural, social, and political. I presented my memoirs related to my personal and professional experiences as a teacher and teacher educator. While doing so, these personal narratives are a way of connecting the personal narratives to the cultural practices by reflecting on the role

of one's own self as a participant in an ongoing social and cultural practice as mentioned by Reed-Danahay (1997). The elements of self-critical awareness on the narratives and articulating the enough spaces to deconstruct, to reconceptualize and transform classroom practices in teaching and learning mathematics created foundations for critical autoethnography. I believe unfolding my experiences in this study fulfilled the purpose of autoethnographic inquiry as mentioned by Das and Mullick (2015), writing autoethnography and experimenting with textual fragmentation and formatting might capable us to extend our understandings of personal emotions/feelings which is primarily underlined in personal experiences (p. 265).

Looking Back to My Theoretical Referents

I chose three theories as referents. Those theories were Living Theory Methodology (Whitehead, 1989, 2008), Transformative Learning Theory (Mezirow, 1991) and Knowledge Constitutive Interest (Habermas, 1972). In this section, I discuss how I used theories in my study.

The main purpose of my study was to improve my practice re-examining my own beliefs and existing practices about the nature of mathematics, pedagogical practices, curricula and assessment. I, as a teacher and teacher educator, have been seeking the better alternatives all the time in my professional context believing that there are always enough spaces to improve. Living Theory Methodology provided me enough grounds to ask questions of the kind 'How do I improve what I am doing? Whitehead (2008) explained, "A living 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).Throughout the chapters, I presented my stories offering the sufficient

explanation aiming at demonstrating my lived experiences. While doing so, the stories I told are those of myself in company with others who were also telling their stories (McNiff, 2013). I have tried my best to show the significance of 'I' as a living contradiction, which is considered as a necessary component in Living Theory Methodology.

Another theoretical referent I chose was Transformative Learning Theory rooted in the work of Jack Mezirow in the area of adult education in 1990/91. Regarding how we make sense of our experiences with the world from the subjective perspectives, Mezirow drew the ideas of well-known philosophers such as John Dewey and Jurgen Habermas. I was frequently trying to make sense of my various professional episodes reflecting critically on the presuppositions underpinning my/our values and beliefs, which is one of the key components in transformative learning. During the time of presenting and "analyzing" my narratives, I attempted for critical awareness on my own past, present and possible future being aware of the world where I live. While doing so, I believe I was guided by the Transformative Learning Theory as mentioned by Morrell and O'Connor (2002, as cited in Taylor, 2015).The focus of transformative learning is on expanding conscious awareness of our situatedness in the world or, to put it more simply, in our understanding of who we are and who we might yet become, both as individuals and social beings. I have grown up in a traditional village life style, non-western society and in less-affluent country with embodiment of post-colonial thoughts. In this context, I think transformative learning helped me a lot preparing towards critical-self-reflective citizen contesting taken-for-granted social norms in the field of mathematics teaching and learning and making ethical judgment toward equity, justice and democratic practices.

While preparing the chapters, it was very difficult for me to identify ways to deliver and envisage my thoughts in a path of transformative learning. The interpretive paradigm provided me with a space for cultural-self knowing by making sense of my personal-professional experiences, and how underlying values, beliefs on the nature of mathematics and mathematics teaching gave rise to classroom practices. The theories I learnt and beliefs I held have been drastically modified with the interaction of my community of practice. This is how I was able to negotiate meanings from the lens of relational knowing. The critical knowing allowed me to examine (in) visible powers that governed our practices, and defined our relationship with the world. In many cases, I tried to envisage better perspectives on the nature of mathematics and better approaches that should be developed to view Nepali mathematics education.

Habermasian knowledge constitutive interest (1972) was another theoretical referent I employed in my research. The notion of interest according to Habermas is different from the common notion of interest that shows a desire or an inclination towards some activities to gain pleasure. The notion of interest here describes human ability to pursue goodness or wellbeing through knowledge and reasoning. Three knowledge-constitutive interests (i.e. technical, practical and emancipatory) are rooted in human existence and expressed in a particular type of inquiry.

During the course of research proposal development, I tried to be away from the notion of producing knowledge trough technical interest. The practical interest presupposes and articulates the modes of action-oriented (inter)personal understanding that operates within the socio-cultural form of life with the help of ordinary language and communication. While doing so, it was noteworthy in my case while drawing the meanings out of my narratives of the professional context. Though

I was fascinated with the emancipatory interest, I came to realize that there were no royal roads that led to emancipation, and it could not be acquired in a short period of time. The emancipatory interest, however, turned out to be useful to develop awareness with the false consciousness, which is a new form of hegemony, on the various episodes of my life as a student, a teacher and teacher educator. From the perspective of knowledge constitutive interest, I tried to be aware of various disempowering forces that were constraining me for a longer time. In this regard, I found Luitel's (2009) remark relevant, "I hold the view that bureaucratic language promoted by the nature of mathematics as a body of pure knowledge is less likely to promote constraints free communicative situations as many students still struggle to understand the nexus between universalised language of mathematics and its relation with their lived reality." (p. 86)

At this point, I realized that the over trust with the certain form of knowledge construction does not function well in our classroom teaching and professional life. As a practitioner, the balance is very essential. I agree with Presmeg's (2014) articulation that instruction (behaviorist emphasis) and construction (pupils' active involvement) can mutually constitute each other in a fine-tuning awareness. She has explained this connection through the metaphor of "dance" in knowledge generation process. The good part of taking Habermasian knowledge interest as a referent in my study is that it helped me realize that the use of one sole approach is not enough; the wise choice is required while applying those theories in context.

Responses to the Research Questions

I discussed in the earlier section regarding the pain while giving birth to the research questions. I travelled through various modes with many research agenda in the beginning and finally landed on a few tentative research questions. At the time of

developing “analysis” chapters, those tentative research questions got refreshed many times with multiple sittings with the research supervisor. At this time, this study has the following research questions.

1. In what ways have my beliefs towards the nature of mathematics been developing from absolutist to fallible, and what sorts of belief system is likely to promote inclusive nature of mathematics?
2. How have I been developing my beliefs towards mathematics curriculum, and how do I develop an inclusive and transformative vision for a mathematics curriculum in the Nepali context?
3. How have I been developing my beliefs towards the pedagogical practices, dominant in the field of mathematics education in Nepal, and how can my “critical pedagogy” be helpful as a good alternate pedagogy for Nepali society?
4. How have I been developing my beliefs and practices towards students’ assessment, and how do I envisage the better assessment practices that promote assessment as an inseparable and continuous part of teaching and learning?

I developed separate chapters for each research question to capture my beliefs and assess my practices on different constructs. While doing so, I tried to use multiple genres in my writing believing that writing as an inquiry (Richardson, 2000) could be the major way to address the research questions.

I attempted to unfold my beliefs about the nature of mathematics as a student, teacher and teacher educator, and its influence in classroom teaching. I have experienced the absolutist nature of mathematics almost all the time during my schooling and a significant amount of time in my higher studies. It was very difficult

for me to come out from the notion of core mathematical world to soft mathematical practices. My deep-seated beliefs in the absolutist nature of mathematics could not easily welcome the notion of fallibility in mathematical knowledge and practice in the beginning. The self-justificatory approach of proving mathematical facts and theorems could not take me (us) outside the classroom, and did not provide opportunities to interact about the mathematical practices in the society.

The work of Ubiratan D'Ambrosio in the field of ethnomathematics and its pedagogical implications opened my eyes about the cultural nature of mathematics. It helped me to understand the fallible nature of mathematics in my context. In some narratives, I discussed my values and beliefs through the lens of absolutist and fallible nature. Regarding the alternative perspectives on the nature of mathematics, Lerman (1990) advocated that the notions of proof, truth and rigor can be seen to be relative values, and there are conceivably alternative possibilities for the development of mathematics (p. 55). The 'either …or' dimension of logic created lots of problems in my thinking. I was neither completely advocating for fallible nature nor rejecting the notion of absolutism. My thinking falling on the extreme of two thoughts could not be useful while applying that notion in classroom teaching. I was seeking spaces in the field of the nature of mathematics that allowed me greater spaces which can carry both the extremes and other possible thoughts that appear in between. The paper by Luitel (2013) advocating the inclusive view of the nature of mathematics as an im/pure knowledge system challenged my beliefs of 'either…or' dualism of doctrine. He emphasized the notion of 'im/pure' inclusive space for conceiving the co-existence of different forms of mathematics. The Vedic dialectics of 'neti-neti' (i.e. neither THIS nor THAT) was used as a structural referent in the paper, which helped

me to shape my beliefs – mathematics as the body of pure as well as impure knowledge.

I attempted to examine my beliefs about the curricula of mathematics to respond to the second research question. I discussed how I had conceived the notion of curricula at the beginning. The shift I took from the perspectives of Hilda Taba, Ralf H. Taylor, Saylor and Alexander to various curriculum metaphors (Schubert, 1986) was a turning point in the course of viewing curricula in my professional context. I discussed the dominant images of mathematics curricula that perpetuated a mono-cultural worldview in Nepali classrooms - curriculum as subject matter, discrete tasks and concepts, cultural reproduction, etc. I also examined my own beliefs and practices on how bureaucratic, hierarchical and repressive culture has shaped and facilitated my thinking and action regarding the implementation of curriculum. In this regard, Pinar's (1978, 2004) argument "curriculum as currere" involving the investigation of the nature of individual experiences, artifacts, actors, operations of the educational journey or pilgrimage, made me thoughtful about the individualized nature of curriculum and its possibility in our context. I was not satisfied with the lecture given by a well-known professor on *curriculum* and his explanation of *currere*. I tried to capture some thoughts of the professor and myself through the e-mail communication. I believe the letter I wrote to the professor and his response provokes the issues on the deep-seated beliefs towards the traditional view of curricula and the new movement. It also helps to understand how the metaphor curriculum as currere has been used in different ways.

I, then, presented my ever-changing beliefs on the curriculum through the notion of culturally contextualized mathematics curriculum. This is yet another epiphany I gained in the journey of my professional context. Of course, it is a

challenging job to develop culturally contextualized mathematics curricula in our context of multicultural society, but teacher level contextualization should be a matter of teachers' enthusiasm for enacting the existing curriculum by incorporating local content, pedagogical models and examples as discussed by Luitel and Taylor (2005). I advocated constructivist oriented pedagogy and transformative pedagogy to serve the culturally contextualized mathematics curricula in my narratives. From theoretical referents, I discussed how Habermasian technical interest governed our thinking and practice in both the central and the local levels. While discussing the comparatively newer form of curriculum practice, I attempted to assess how curriculum design is regarded as a process through which pupil and teacher interact in order to make meaning of the world from the perspectives of practical interest. I used emancipatory interest that allowed me to promote counter-hegemonic vision of curriculum, raising critical consciousness towards taken-for-granted assumption of curricula.

I responded to the third research question with my narratives of teaching mathematics at different times and in different contexts. I tried to re/present how I have been shifting from a lecturing teacher to a critical pedagogue. I spent noteworthy time to discuss how I was compelled to search a lot of tricks, tips and techniques to teach mathematics as a school teacher. The idea of humanistic pedagogy (Hersh, 1979; Ernest, 2012) realized the urgent necessity in our Nepali context where students are not treated as human in majority of mathematics classes. The story of Finland from "problem solving" movement in mathematics to seemingly "humanistic approach" has created space for readers to pedagogical reform in some ways. Van Manen (1991) suggested that in pedagogical field, nothing is ever completely foreseeable, predictable, and manageable. We have the opportunity to think reflectively through the significance of the situation.

I presented how I started reflecting on my practices of classroom teaching and transformed myself according to time and context rather than searching for better techniques in literatures. I used the essence of *reflection-in-action, reflection-for-action* to investigate and develop contextual pedagogical approaches in my teaching. *Mathematics teaching as a political act* was the belief I held during my post-graduate study. I understood the notion of politics in teaching mathematics from the perspectives of critical pedagogy for social justice. I came to realize that we, as teachers, have been doing "politics" saying that there should not be any politics in teaching and learning. No act is free from polities. My understanding of the political act in the pedagogical act is to develop critical awareness in students through mathematics teaching where we have been seriously affected by westernization and universalisation in the name of globalization.

The final research question was developed to assess my beliefs and practices about the classroom assessment practices while teaching mathematics. I responded to this question through the engaging narratives of my professional experiences beginning from the conventional notion of assessment (such as written test) – i.e. test, to multiple ways of authentic assessment practices (such as continuous assessment, performance based assessment, portfolio assessment).

I began the chapter with the narratives that captured the existing practices of the SLC examination. The *Iron Gate* was used as a metaphor for the SLC examination. My purpose was to present the current status of our national examination system, and critically assess the psychological and social fear among students and parents created by such a standardized test. I narrated my experiences of formative and summative evaluation systems. I tried to articulate the beliefs of the school principal towards formative assessment and the difficulties I faced while

applying the notion of formative evaluation as a teacher in school. In some narratives, I was trying to raise voices against those teachers and school leaders who tend to understand that assessment should be done by the external body in the name of independent evaluator. My efforts were evoking the roles of classroom teachers in continuous assessment system, and how assessment can/should be embedded in teaching and learning activities as an inseparable ingredient.

The moments I spent at New Age University for my Master's level study turned out to be remarkable in terms of taking a shift from narrowly conceived theoretical understanding of continuous assessment system into the classroom practice with rich intent. I, then, realized that it is necessary to challenge the traditional mindset of the teachers who see themselves as controlling authority and reluctant to practice alternative forms of assessment (Dayal & Lingam, 2015).

At the end of the chapter, I assessed my overall beliefs and practices of classroom assessment from two broader perspectives of learning tradition – behaviorist and socio-constructivist. I argued that teachers with the behaviorist mindset believe learning as a transmission of knowledge, leading to a narrower view of assessment in which testing and examinations become the ultimate approach in themselves with the focus on reproducing knowledge and measurable skills. In socio-constructivist view, assessment is viewed as socio-cultural activities in which the learners are viewed as constructivist participants believing that each learner has special attributes, and assessment should identify such unique attribute for further enhancement. The continuum of beliefs on assessment as a construct and experiences of using them into classroom practice molded me to being a pragmatic and conscious teacher.

Painful and 'Aha' Moments

I began a journey many years back. In fact, I was not thinking of joining the M Phil program in the beginning. I was a very busy and demanded teacher in a reputed private college after I earned the Master's degree. I was enjoying teaching and thus wanted to continue it for a few years. During that time, New Age University launched M Phil program in Mathematics Education. I had just started my career as a visiting faculty at the same university. I thought it was necessary to join the M Phil program to develop my career at the university level. There were many painful and cheerful moments in the journey of my M Phil study, especially during the course of research writing.

Let me begin with some of the unforgettable painful moments. I wanted to fix my research topic and questions on day one, and develop a clear path to be followed during my research work in advance. I tried, but I couldn't. I spent a lot of my time and effort in identifying my research agenda. Those were the painful moments when the research agenda kept changing and new research questions emerged in the process of writing. I chose autoethnography as research methodology believing that re/examining my beliefs and practices on the nature of mathematics, pedagogy, curriculum and assessment would help me strengthen my beliefs and thus improve my practices. While making the narratives public, I was thinking that the readers might feel my stories and would be benefitted in some ways. But, the moments I began writing my narratives were very annoying in many ways. I had nothing on my hand. I had thousands of episodes of experiences - which experiences were to be included and which not.

While writing the autoethnographic research, Custer (2014) mentioned that it is not an easy task to relate to whom we were in the past and understand how that

translates into our identity today, but it is worth the effort in order to reap the rewards of reflexivity and introspection. Another problem I faced was how much vulnerable I had to be while writing my own stories. My supervisor always suggested being engaged with myself. For me, being engaged means bringing right amount of vulnerability in writing as mentioned by Brown (2012), who declares, "We need to feel trust to be vulnerable and we need to be vulnerable in order to trust" (p. 46) in the context of writing stories of oneself.

My silence for a long time during the research process was the great loss for me. On the other hand, there were many 'Aha' moments in the course of time. The greatest joyful moment for me was when I came to know, from various literatures, that the above painful moments were felt by almost all the novice auto-ethnographers. I was not an exception. While writing my narratives, I enjoyed a lot memorizing my past and critically assessing my assumptions and values behind my practices. The moments I shared in pieces my narratives with my students and friends developed confidence in me to move ahead. The positive and encouraging feedback provided by my supervisor always inspired me to go ahead.

Who am I at Present?

As an autoethnographer, it is very essential to share my present positionality. In the first chapter, I mentioned that the major purpose of this research was to improve my own professional practices by examining the deep-seated beliefs and day-to-day professional practices. During the time of this study, I engaged myself as a critical reflective practitioner. Although it is very difficult to share the changes that occurred in my professional life due the nature of the research in which I deeply engaged for a long time, there are many changes that I felt worth sharing.

There were four major themes in my research - nature of mathematics, curriculum, pedagogy and assessment. After the engagement in this research study, I made more vivid understanding in those four themes. I got ample opportunities to read papers and critically reflect on them in relation to the four themes. While doing so, I gathered both local and global perspectives and examined my beliefs and practices from both lenses. These all incidents prepared me as a critically aware teacher educator in terms of understanding and describing the four major themes of mathematics education.

As a teacher educator, I think developing various ways of thinking is an essential skill to be flourished. The journey I took during the research process developed a lot of skills on the ways I think. I believe that there are no straightforward and ready-made approaches to solving the professional problems in teacher education (such as, pedagogy, curriculum, and assessment). In this context, I realized that I began perceiving the things differently and tried to come up with the various alternatives that possibly address my professional problems.

As a mathematics teacher, I spent a lot of time considering that respect should be given by the juniors to seniors and by less "talented students" to more "talented students". At this point, I am taking the notion of respect as an important phenomenon but differently. Everybody should respect each other. I developed a sense of self assertiveness. The respect of ideas and perspectives are more important than the respect given to elders. I think this is one of the ways of ensuring the inclusiveness in teaching and learning. I realized that these skills have been shaping my professional life, which is one of the major contributions of this research activity.

My Future Direction

My post graduate study developed a sense of responsibility and courage to move ahead in the field of education in general, and mathematics education in particular. I am interested in going ahead in the research field widening my thoughts in mathematics education. I do hope that I will continue my further study and practices on Transformative Education Research (TER). I believe that TER is very much appropriate in the context where I live and practice in academia.

A major essence of the neo-colonial project is the Western education export industry and international benchmarking in education systems. These practices have maintained the "official knowledge" production agendas of education systems worldwide. The modern education system produces highly skilled professionals in the field of developing infrastructure and social services. My argument is that these are essential but not sufficient. It seems that the enough care for the local cultural capital has not been given in our curricula and teaching and learning. In this context, the transformative education may orient us towards the sustainable and inclusive practices in teacher education. As a teacher educator, I am interested in moving towards the themes of TER in the days to come. For this, I believe that TER provides me a lot of opportunities to prepare the 21st century teachers and trainers with higher-order abilities so that they can develop transformative curricula, teaching approaches, and community development programs that promote sustainable development.

In this context, 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. I will be using various critical theories in my future research assuming that those theories would play

a vital role in observing the scenarios in different ways and transforming the researcher into a conscious practitioner.

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