Science and Mathematics Education Centre

NARRATIVE EXPLORATIONS OF NEPALI MATHEMATICS CURRICULUM LANDSCAPES: AN EPIC JOURNEY

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ABSTRACT

This study portrays my experience of learning and teaching mathematics as a student, a teacher and a teacher educator. Specifically, it encapsulates my epic journey of inquiry into the cultural contextualisation of mathematics teaching and learning in Nepali schools. Organised into six main chapters, it concludes with a construction of actual and preferred qualitative maps of Nepali mathematics curricula in which I have studied and taught. Subscribing to arts-based autoethnographic methods, my research epistemology has been facilitated by knowing as phronesis, storying, deconstruction, interpretation, transformation, and reconceptualising *self*. With the main focus on my own educational journey, I have used multiple genres, such as story, poem, dialogue, and drama, to represent and interrogate my lived experiences. Because I have provided rich and thick descriptions of my educative landscapes, it may be possible for the reader to transfer this inquiry's epistemology, methodology and pedagogy to his/her own research and pedagogic contexts.

DEDICATION

To my parents whose ideals have been guiding my life along a valuable educational journey

To my teacher (and brother) Ram Chandra Luitel (posthumously) whose honesty, dedication and educative role inspired me to be a good teacher

To my wife, Sabita, whose care and continuous support made my 'uni-life' easier

To my son, Bijaya, who is my future hope…

To all my teachers who gave a thousand lights of knowledge

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TABLE OF CONTENTS

ABSTRACT ii

ACKNOWLEDGEMENTS iv

TABLE OF CONTENTS v

LIST OF FIGURES vii

PROLOGUE MY JOURNEY OF *NIRVANA*

My brief journey of education 1

A brief journey of my methodology 4

My journey towards (multi)textual representation 6

Overview of my report 9

CHAPTER 1 MY SCHOOL DAYS: A CANVAS OF FOREIGN MATHEMATICS

Tales of ‘foreign mathematics’ 12

Rural school, sacred mathematics and elite science 22

Power, democracy and mathematics 30

CHAPTER 2 CONSTRUCTING MEANING FROM MEANINGLESS MATHEMATICS

Pseudosphere and Nepali Shanai 37

Rethinking subject structure and pedagogy 44

Fragmented methods and integrated contexts 50

CHAPTER 3 TEACHING (OTHERS’) MATHEMATICS: AN EXPERIENCE OF TIME, TEXT AND TEACHING

Redefining my role in others’ mathematics 58

Conceptualising ‘time’ of teaching foreign mathematics 64

CHAPTER 4 ENCULTURATION, POWER AND MATHEMATICS

Enculturation, pedagogical tactfulness and reform 70

Social and cultural dimensions of mathematics 75

Searching for our history of mathematics 81

CHAPTER 5 MULTIPLE IMAGES OF SCHOOL MATHEMATICS CURRICULA: EXPERIENCES OF A TEACHER EDUCATOR

Curriculum, Self, Other and Voice 90

Curriculum and cultural enactment 95

Curriculum, experts and teachers 99

Mathematics, interest and power 104

Inclusive curriculum and language 109

CHAPTER 6 CONCLUDING MY RESEARCH LANDSCAPES: A SYNTHESIS VIEW

My background as a researcher 114

Learning through the journey of Border Crossings 115

My research questions 118

Some future possibilities 127

Epilogue 129

LIST OF REFERENCES 130

INDEX 136

LIST OF FIGURES

1. Triangle (i.e., trilateral) in hyperbolic geometry 20
2. Nepali Shanai and (the upper half of) a pseudosphere 37
3. A model showing hierarchical relationships between cardinalities 78
4. The relationship between subjective and objective/[intersubjective] knowledge of mathematics 80
5. A sample sketch of Bell 87
6. My actual qualitative map of school mathematics curricula of Nepal 125
7. My preferred qualitative map of mathematics curricula of Nepal 127

PROLOGUE

MY JOURNEY TOWARDS *NIRVANA*

> Look back how it was with those who came before, look forward how it will be with those who come hereafter. A mortal ripens like corn, like corn he springs up again.[1] [*Katha Upanishad (Translated by Max Muller)*: Verse 6, Part 1, Canto 1][2]

In this way, *Nachiketa*, the knowledge seeker of *Katha Upanishad*, explains human life as a cycle of birth, life and death. For me, the cycle also can be depicted as past, present and future dimensions of our experiential lifeworld. Given the *three dimensional* metaphor of the experiential world, this study embodies my experience as a learner, teacher and teacher educator. Because this type of study is situated in an alternative (i.e. postmodern-constructivist) paradigm, its representational as well as methodological issues need to be elucidated in order to ease the journey of the readers. With this view, I have tried to delineate the issues under three main sections: *My brief journey of education*, *A brief journey of my methodology*, and *My journey towards (multi)textual representation.*

My brief journey of education

My educational journey started in 1979 from a rural primary school in Nepal. As a result of wondering why there were no stories in my primary school mathematics textbook, I constructed the image of mathematics as a *foreign subject*. During my secondary education, this image remained unchanged as the school management had

[1] अनुपश्य यथा पूर्वे प्रतिपश्य तथाऽपरे |
सस्यमिव मर्त्यः पच्यते सस्यिमवाज्यते पुनः||

[2] Upanishads, the sacred Hindu scriptures, have been represented in the form of dialogues between the Teacher and a disciple, a sincere truth seeker. *Katha Upanishad* has been represented in 120-verse dialogue between Yama, the death himself and Nachiketa, a young teenager.

to cross the southern border to find *Indian teachers* to teach Nepali mathematics. Because of the lack of mathematics teachers in the rural secondary schools, I planned to pursue a mathematics education course in my tertiary education. I constructed an image of mathematics as *inexplicable in Nepali* while studying at the *intermediate level*[3]. *Meaningless mathematics* was the main image of mathematics during my subsequent bachelor's degree studies. Whilst teaching from an Anglo Indian mathematics textbook to Nepali students, I witnessed that cultural, conceptual and lingual contradictions were the major hindrances to student learning. *Mathematics-teaching-as-reproduction-of-theorems* and *mathematics-as-collections-of-unchangeable-definitions* were some of the images I constructed during my first Master's course. In the meantime, I had developed a *dim* image of ethnomathematics as *mathematics of the people*.

After a brief career in a local teacher education college, I joined Kathmandu University[4]. I saw many problems of teaching and learning mathematics in the schools of Dhulikhel Municipality[5] where I worked as a mathematics educator for an in-service teacher-training programme. This field-based experience helped me to connect between, and understand the landscape of, university teaching, pre-service and in-service teacher training, and school mathematics teaching. Specifically, Dhulikhel Municipality was my field where I acted as a trainer, supervisor, video-recorder, demonstrating teacher, university lecturer and so forth.

Shifting my workplace from the crowded university classroom to resource-poor semi-rural schools set me on a new journey of teaching and learning mathematics. I constructed a range of images of mathematics, from *mathematics-is-what-teachers-say* to *mathematics-as-storytelling*. To embed local cultural contexts within teaching and learning mathematics was one of the outstanding problems for teachers who were mostly unaware of how to make mathematics inclusive. Nevertheless, I also had limited experience and awareness of how to embed local contexts in

[3] Similar to senior/higher secondary level.
[4] Established in 1991, Kathmandu University runs undergraduate and (post)graduate programs within Arts, Education, Engineering, Science, Medical Sciences and Management Schools: Link: www.ku.edu.np .
[5] Dhulikhel Municipality is situated to the northeast direction of the capital city, Kathmandu. It is a small and famous place for 14th/15th century old Nepali cultural traditions and artefacts.

mathematics teaching. However, supervising mathematics teaching provided me with rich references for reflecting upon the context, the subject matter and this approach of teaching. Over time, I learnt that each observed lesson was unique in terms of approach, temporality, person, context and content.

In the meantime, the Nepali school mathematics curriculum changed in response to the government-generated rationale which argued that secondary school graduates were *weak* in basic mathematical knowledge and skills. Consequently, new content was included in the new school mathematics curriculum. The context of curriculum change created a chaos-like situation among secondary school teachers because most of the new content was unfamiliar to them. Nevertheless, according to the teachers, the inclusion of new content did not make any significant difference to their practice. The curriculum materials – textbook, teacher's guide and assessment-related documents – were also the subject of criticism by teachers because of their decontextualised nature. On the contrary, the curriculum designers, textbook authors and university professors were of the opinion that the school curriculum needed to introduce other important mathematical concepts. Talking to the experts revived my initial image, *mathematics-as-a-foreign subject*. However, visiting schools and reading the faces of the students and their original mathematical thinking did little to enable me to accept this image.

Formally, I started reflecting upon my experiences and integrating them with the emerging theoretical perspectives of mathematics teaching and learning after I became an internal postgraduate student at Curtin University of Technology. With my sensitivities towards improving my practice and helping others to improve, I tried to explore ways that could liberate me from my own constraints, especially related to thinking and acting. From my previous experience of formal education, I did not expect this type of professional development opportunity through a degree-based programme. However, this journey proved to be very different. Subscribing to constructivism and many other theoretical perspectives, I started to realise that my educational journey was more complex and multifarious, as though a canvas of *multicoloured* art.

This journey has been painted throughout my research. Having subscribed to *writing as inquiry* (Richardson, 2000), I have embraced the notion of *writing as connecting my experiences of teaching and learning* and putting them into local and global perspectives. Next, I will tell you more about my research methodology.

A brief journey of my methodology

When I read Parker Palmer's (1998) book, *The Courage to Teach*, I was enlightened by the idea that a teacher needs to explore meanings of the *what*, *how*, *why* and *who* of teaching in order to understand his/her landscapes of teaching. As an educator, who has to educate and help to improve others' pedagogy, I was in need of a method that perhaps could help me prepare a background for exploring contextual answers to those questions.

Having a strong background in the behaviouristic-cognitive pedagogical tradition, initially it was not easy for me to understand the unstructured postmodern-constructivist world. Gradually, the poetic, soulful, deconstructive and ironic nature of postmodernism seemed appropriate for representing complex educative phenomena. Specifically, reading Patrick Slattery's (1995) book, *Curriculum Development in the Postmodern Era*, gave me fresh thinking for exploring the 'knowledge of stillness' of my own teaching and learning. At this stage, I became interested in autobiographical representation of my knowing.

I began to explore the possibility of conducting research by using a fictional plot to represent a recent educational context in which I had worked as a mathematics educator. With some interest in literature, I was attracted by Denzin and Lincoln's (2000) depictions of the latest 'moments' of qualitative research, especially the process of crystallisation of narratives and critical ethnographic research enterprises. However, my ambition of fictional writing would not fit within the given timeframe of a one-year masters' project. On the other hand, I had also thought of researching students' conceptions of alternative geometries such as hyperbolic and Riemannian. Indeed, my focus on non-Euclidean geometry was motivated by my dissatisfaction with the monological pedagogy of existing geometry. However the area of non-Euclidean geometry could not help me explore the following broad questions:

- *What have I been taught/ teaching?*
- *How have I been taught/teaching?*
- *Why have I been taught/teaching a particular topic?*
- *Who am I that has been taught/educating*?

These questions took me close to my educational journey. I found that my questions and problems were related to my professional practice within my cultural context. Gradually, the issue of *culture* and *self* (Giroux, 1992) emerged as one of the foci of my research. This gradually led me to take my own *experiential warrant* for exploring my personal practical knowledge (Connelly & Clandinin, 1988) through my *window* of lived experience. Specifically, during the process of conducting the research, my research problem(s) emerged, and were crystallised to explore the cultural contextualisation of mathematics curricula of Nepal in which I had studied and then taught.

In the next detour of my journey, I started to explore a series of experiential relationships between my educative contexts and myself. Reconceptualising relationships between self and other took me into the world of autoethnographic genres. I constructed the meaning of autoethnography from Ellis and Bochner (2000) as a means of exploring multiple meanings of my situatedness in multiple educative contexts. Subscribing to autoethnography as a main methodological referent directed my journey towards a process of (re)conceptualising my values. In the past, I had embraced the notion that personal values and professional life were separate entities. However, in conducting this research I explored how my personal values cannot be separated from my professional life. Furthermore, Cobern's (1991) examples of different and often confronting worldviews from his teaching and learning landscapes drew my attention towards my own personal values and their implication for my pedagogy. I integrated this fresh and sensible idea with the notion that autoethnography is not a single method but an 'embedded methodological praxis' (Spry, 2001). However, the journey of reconceptualizing my values and understanding my methodology continued throughout my research: it did not stop with my proposal writing.

I found that Max van Manen's (1990) powerful idea of *writing for pedagogical thoughtfulness* helped justify the need of self-study narrative research in the field of

pedagogical inquiry. Similarly, Clandinin and Connelly's (2000) notion of *pedagogical wakefulness* was another dimension of my methodological journey. Gradually, I (re)conceptualised that knowing as *phronesis*—practical dimensions of knowing — and as *poesies*—aesthetic and moral dimensions of knowing (Wall, 2003) could help me explore and represent my claims of knowing through my experiential landscapes. Along with ways of knowing such as deconstruction, transformation, and personal reconceptualisation, my methodological adventure took me along the path of *practical knowing*.

During my journey, I continued to perceive the intertwined relationships between the epistemology, ontology and methodology of my research. In the beginning, I was not clear about my epistemologies although I had spelt out that I would subscribe to postmodern-constructivism. As *Nachiketa* went to see *Yama* to explore the ultimate reality of death, life and knowledge, I used my experiential reality to explore viable possibilities of pedagogical reforms that are applicable to me. Unlike Nachiketa, I tried to excavate some important implications of my experiences for my professional practice rather than search for an ultimate truth. Thus, my ontology subscribed to subjective approaches for understanding the nature of *being*. In the methodological domain, I used autoethnographic (arts-based) genres in order to *focus on* and *zoom in/out* of some nodal events of my educational journey.

My journey towards (multi)textual representation

Learning that the embrace of autoethnographic methods requires a justifiable portrayal of my knowledge claims, I tried to find legitimate ways of (re)presenting my texts. However, searching for a template seemed to be incompatible with my epistemological standpoint(s). This struggle gradually led me to search for possible cures for what Denzin and Lincoln (2000) call the *triple crises*: *representation*, *legitimacy* and *praxis*[6].

[6] Representational crisis is related to a legitimate portrayal of knowledge claim whereas crisis of legitimacy is a tension between an ontological reality (i.e., data) and its represented reality. The third crisis is to deal with the *theory-practice dualism*.

I came to know that addressing the representational crisis could help address the other two crises as well. Indeed, I realised that it is very hard to claim that there is only one privileged way of representing my 'data'. Perhaps, my longstanding attachment with the mono-representational educative enterprise created confusion in me while dealing with this open and emergent type of inquiry. Grappling with the representational issue, I tried to make sense of John van Maanen's (1988) idea of *impressionistic tales* for providing spaces for readers to create their own meaning from the text. Initially, it was very hard for me to see any obvious relationships between the crisis of exploring a justifiable form of representation and subscribing to John van Maanen's notion of *textuality*[7]. Gradually, I started to perceive that *textuality* could help readers construct their multiple meanings out of my text.

Because I was planning to write impressionistic tales, I needed to explore meaning-embedded plots and composite characters, and use some 'literary criteria' (Denzin, 1997) such as ensuring *dramatic control* and *verisimilitude* and embedding *fragmented knowledge* (Van Maanen, 1988). Discussing with Peter (my supervisor), I came to realise that multiple genres can facilitate multiple textuality. However, these *theoretical ideas* were not *black and white* for me in the beginning. By then, I had to prepare a structure for my project report. Indeed, I had my nodal moments, some stories, autobiographic vignettes and poems, but my chapters were still *on the way*.

My *chapter structure* changed many times. Specifically, after having a series of discussions with Peter, I realised that a *diachronically guided*[8] thematic structure of chapters would be a sensible form of representation (Polkinghorne, cited in Stapleton & Taylor, 2003). After developing a minimum level of understanding of diachronic representation, I stopped panicking about my inability to make a clear structure. However, in a social gathering with other students and professors, I had to take time—given that I am a slow speaker of English—to explain my research.

[7] The extent to which a textual representation can render multiple contextualised meanings.
[8] Representing research in accordance with the researcher's investigative journey.

Although some of the problems related to 'inter-chapter connections' were addressed by a diachronic structure, the crisis of intra-chapter connections was still unresolved. Primarily, as a non-native speaker of English, I was challenged by the nature of artistic and impressionistic writing. My second obstacle was the style of writing (i.e., dogmatic, deductive, logical writing) in which I had been trained. More than that, the intra-chapter crisis could also be related to the aesthetic tension embedded in my worldview and that of English, which can be labelled as a confrontation due to the *aesthetic imperialistic nature*[9] of English (Schwarz, 2000) over other languages. In essence, the crises of intra-chapter connections can also be a form of representational crisis. As I could not represent everything from my experiential field, I had to select important events, contexts and themes. So the crises could not be resolved completely. In the meantime, reading Eisner's (1997) (hi)story-embedded perspectives on alternative forms of representation gave me a basic level of confidence that there are multiple ways of justifying a textual representation. Therefore, instead of searching for a single way of organising my chapters, I tried to find a feasible and communicable intra-chapter structure. Some available exemplars of narrative research (e.g., Taylor, 2002) also helped me to understand the structural issues as case-based rather than universal. Wallace and Louden's (2002) representational structure of *Stories About Dilemmas of Science Teaching* also gave me some ideas for writing commentaries on my 'data-text' (i.e., the stories and poems).

In this way, I tried to resolve the representational crises by using multiple genres to represent nodal moments selected from my educational history. I considered the research problem and the purpose of *writing as inquiry* as the main referents while selecting nodal moments. I gradually learnt that the crisis of legitimacy could be resolved by representational and literary criteria. It made sense to me that the crisis of praxis could be resolved by transforming my *thinking* and *action* according to the purpose of my inquiry. Furthermore, I came to know that reflexivity – *how/why have I represented my experiences?* – and reflectivity – *what experiences have I*

[9] Because of adoption of English by non-English cultural groups has resulted into disappearance of their languages, especially their aesthetic values.

represented? – can be basic criteria for addressing the crisis of praxis for this self-study research.

Perhaps, praxis could also be explained by the metaphors of *nirvana* and *Katha Upanishad* which I have considered for portraying my prologue. Nirvana, for me, is my state of knowing some important aspects of my professional practice. Indeed, I am not claiming that I am in the supreme position of being enlightened as *Buddha*. However, this journey can be an example that I am in the process of knowing important aspects of my professional practice. *Katha Upanishad*, a widely known Hindu text which I have read more than five times, is an example of using dialogues, stories, analogies, myths and metaphors for representing personal (and social) ways of knowing. However, I am not claiming like *Nachiketa*, who after having a series of dialogues with *Yama* finally knew the 'eternal bliss', that I achieved such a state of elevated consciousness for improving my pedagogy; instead, I have estimated some approaches that I can use to overcome some of the constraints to my future practice.

Overview of my report

Representational issues are intertwined with the issues of reading my text. As one of the purposes of educative writing is to evoke *pedagogical thoughtfulness* in the readers, I need to clarify how the readers can make better sense out of their 'reading journey'. Specifically, I have used multiple genres of representation, namely autobiographic, impressionistic, poetic, dramatic, dialogic and commentary writing. I have tried to immerse the reader into my experiential context by using composite characters and contexts. In a conventional sense, the text represented by '*Comic Sans MS*' font can be considered as my 'data' and the text represented by 'Times New Roman' font can be regarded as my 'interpretations'. However, I cannot make a claim that this distinction holds in every chapter. More than that, I have used this representational style in order to establish a coherence link between my themes, cases and stories. Given this, the following is a brief overview of my *diachronically thematized* chapters.

Chapter One: My school days: A canvas of foreign mathematics

This chapter includes my experience of studying mathematics at primary and secondary schools as well as an intermediate level student. With more than seven stories, vignettes and poetic representations, this chapter has been divided into three sections.

Chapter Two: Constructing meaning from meaningless mathematics

In this chapter, I have portrayed my experience of the uncritical, decontextualised and meaningless mathematics of my bachelor's degree studies. Weaving three different genres – theatrical, letter writing and dialogue – I have organised the chapter into three sections.

Chapter Three: Teaching (others') mathematics: My experience of time, text and teaching

This chapter depicts my experience as a mathematics teacher in a private boarding school in Kathmandu. Specifically, I have reflected upon the dilemma of using a series of Anglo-Indian textbooks in Nepali schools and the consequent impact on meaningful and contextualised learning of mathematics. With poetic and autobiographic writing, this chapter have been represented by two sections.

Chapter Four: Enculturation, power and mathematics

Reflecting upon the experience of my *first* masters' degree mathematics course, I have used a number of reform-oriented pedagogical standpoints in order to depict my experiential reflection (Willis, 1999). This chapter has been structured under three thematic sections.

Chapter Five: Multiple images of school mathematics curricula: Experiences of a teacher educator

This chapter has been constructed on the basis of my experience as an in-service mathematics educator for the schoolteachers of Dhulikhel municipality of Nepal. Depicting mathematics from the eyes of an observer, trainer and demonstrating teacher, I have presented this chapter in six sections.

Chapter six: Concluding my research landscapes: A synthesis view

Structured into four main sections, this chapter recapitulates my inquiry and addresses the questions which emerged through the process of inquiry. Exploring my research landscapes, I have portrayed my actual and preferred qualitative maps of mathematics curricula under which I have studied and taught. Similarly, I have

concluded with an account of my possible future journey in the field of educational research.

CHAPTER ONE

MY SCHOOL DAYS: A CANVAS OF FOREIGN MATHEMATICS

Tales of 'foreign mathematics'

I

'Foreign mathematics'

"Wake up. It's morning". My mother's usual voice made me wake up. It could be any morning in March 1980. The vernal morning was very beautiful with yellowish-red horizons and dark-green eastern landscapes. Sitting on a table-like mat-covered wooden-bed, I reluctantly opened my mathematics book. The pages were distracting me from being within there. My pen was less interested in writing mere numbers than drawing 'the Devanagari one' as a person without hands and with a single leg. "How might the one-legged creature travel around?" I murmured to myself. "Could 'the one' speak to others? If trees and mountains could communicate to each other, why couldn't 'the one' speak?" Unwillingly, I saw my pen began to write the 'answers' to the problems. I barely felt connected with the answers: Instead I was situated aside from them as a disinterested stranger who wanted to know something different.

I had finished everything by eight. However, I was not enthusiastic to say: I finished my homework … hurray. I was not having as much fun doing mathematics as I was reading the story of an eight year boy who had a good time with his friends: crow, camel, elephant, mountain and tree. I used to find myself within the story talking with these friends. During the last week, whenever I opened my mathematics book, my brother's answer --…'because it is foreign therefore it doesn't have any stories'– to my question—why is there no stories in my mathematics textbook?-- echoed in me frequently. However, I had not seen any foreign *creature* until then. My childlike imaginative painting had created a giant built with a big head and eyes, as if the 'foreign' wouldn't have any interest in stories.

Classes were as usual in school. "Did you finish the homework?" asked my teacher. I nodded my head and handed my notebook over to him. His hands moved swiftly from lower left to upper right. After a while, the teacher again came to me and asked laughingly whether I had got an answer to my curiosity of why-is-there-no-stories-in-the-mathematics-book. I told him that according to my brother, mathematics is a foreign

subject so there are no stories. "Oh boy," he continued, "Do you know what is 'foreign'?" Only one word came out of my mouth, "Mathematics".

'Flower-garland for a storyteller and gold-garland for story listeners' is a famous Nepali adage which is mentioned at the end of each story-telling ritual. This indicates the value of (telling and) listening to stories in our cultural contexts. Furthermore, it also indicates the value of reading and interpreting others' stories as the listeners are supposed to be awarded a gold-garland. With this inspiration, my initial narrative journey starts with a realist tale about my experience of primary school mathematics. Gradually, I create an impressionistic plot with a special focus on my theme—*foreign mathematics*—that emerged from my experience. Perhaps, it depicts my predisposition towards the way I had been taught mathematics in my school education. In the very beginning of my exploration, I like to raise a number of questions: Why did I raise this issue? Why did I write this particular story?

Standing upon different nodes of time, I am trying to connect between past, present and future; between yesterday, today and tomorrow; between birth, life and death; and between so many dimensions, facets and incidents by using my narratives. In doing so, a thatch-roofed and local brick-constructed four-roomed hut opens my memory screen by bringing the image of the corn and cattle farm situated in the northern part of the school, and the south-eastern oval from where we used to view the majestic scenery of the eastern Mahabharata hills. During March and April, the place was so beautiful with skeleton-like deciduous trees sprouting new leaves. It seemed that many migrating birds were inviting us to play a game of *hide-and-seek*.

The school's *inside* was not as beautiful as the *outside*. It was not only because of uneven floors, old wooden benches and desks, wooden blackboards, broken windows, a roof with cracks, but also because of the *number-crammed* mathematics. During the first year of my schooling, I had to remember number names, multiplication tables, and to perform simple addition, subtraction, multiplication and division related to the *no-word-problems* of the appended exercises of each lesson. Perhaps, I would be happier if I was assigned to count the cattle of the nearby farm. I would learn more meaningfully if I was asked to find the total number of pebbles

kept in two bins. However, there were many mismatches between the world of a six-year child and the world of adult-oriented mathematics.

There were many instances that starting school involved going away from the mathematics of the outside world. Once, my teacher asked us to write the word *unit* in the top right cell and *ten* in the left one. Giving an example, he told us to follow the example in order to write all the given numbers in tabular form. I drew many tables and put the numerals in the places labelled unit and ten. But I never understood why the unit-placed three was smaller than the ten-placed two in thirty-two. In retrospection, writing numbers was an independent act from knowing numbers in context. We did not have *base ten blocks* or *Cuisenaire rods*, nor did we have expensive *counters*: instead, our school used locally available materials—wooden blocks, used-match boxes, small pebbles, and used papers—to develop our number sense. Most importantly, there was a need to bring mathematics from outside the textbook and the four walls of the classroom—which Nunes, Schliemann and Carraher (1993) label as *street mathematics*. In my experience, the widening rift between street and school mathematics dispelled the image of mathematics as a *we-friendly* subject.

Searching for possible reasons for my brother's image of foreign mathematics takes me into his bookcase with *Hall and Knight's Geometry*, *Ganguly's Algebra* and many others of his high school textbooks. Perhaps, he was never taught that mathematics could be constructed from our day-to-day life experiences. Instead, he was taught that mathematics needed to be learnt from voluminous books written by foreign writers. His *would-be* foreign image of mathematics might have been strengthened further during a ten-month teacher-training programme he completed in the mid-seventies. Presumably, the training was organized in a resource-rich setting for enhancing village-teachers' practice by using suit-clothed experts' exported knowledge.

II

'I Have No Language'

"Repeat it," commanded the head teacher. Sukra repeated the word "sristi[10]" many times but could not pronounce it correctly. The head teacher warned him that he would fail in the oral test. His face became dark. Sukra repeatedly told the teacher that his tongue was very bad so that he could not speak the Nepali language properly.

It could be any of the weekdays of October 1981. My brother and the head-teacher both appeared in our classroom. We became silent and motionless as statues. Both teachers were moderately kind persons. However, if we made any mistakes, the head teacher would lose his temper. My brother did not usually show an angry face, however, many were aware of his unique and funny way of punishing students—putting a small pencil between two fingers and pressing from both sides. On that day, they asked each of us to pronounce correctly Nepali words and number names.

As Sukra could not pronounce many Nepali words, they asked him to pronounce some number names. However, he could not do this either. Sukra was a mature student. He was tall and fat. I noticed that students from the Rai[11] community found it difficult to pronounce many Nepali words.

By the end of the class, both teachers asked the 'problem students', who could not pronounce correctly, to go outside and practice the words many times. They had been labelled as 'outsiders'. The process of testing students' tongue went on continuously until only five students out of thirty-five remained as 'insiders'. After a while, both teachers disappeared from the scene as though they had completed their drama.

We noticed that the outsiders were assigned to read some lessons very loudly so that their tongue could be improved enough for the Nepali language. I could guess that some of them were reading a story and others were drilling multiplication tables and number names. Being insiders was a mix of pride and glumness: our ' tongue' was good for the

[10] A Nepali word, borrowed from Sanskrit language, signifying an act of creation.
[11] A community of the eastern high terrain of Nepal, resembling Mongoloid people.

Nepali language but we had to complete two sets of exercises before the next break.

They stayed outside for a while and came back into the classroom. We mixed together again. Sukra came to my place and asked about the mathematics exercises. I laughed at him because he could not speak properly though he was bigger than me. "Don't laugh, Balchandra," he continued, " Show me your mathematics exercises." I used to show him my completed exercises because he used to bring his farm-grown fruits for me. Implicitly, we had a reciprocal relationship: I used to help him do mathematics and he used to give me fruits.

"Can you say 'ekkais'[12]?," I asked him. I was trying to entertain myself with his funny (for me) style of speaking.
"Why do you tease me?," he continued, " I cannot speak properly. It is not my language. It is the Chhetri-Bahun's[13] language."
"Really? What is your language?," I asked.
"We are Rai people. We have our own language. However, I cannot speak my language nor can my parents. Now I cannot speak Nepali. I have no language."
After his confession I could not ask any more questions. My small brain was trying to make sense of his last sentence – I have no language.

Sukra's last sentence continues to echo in my mind, and helps me revisit my three-grade primary school's cross-cultural context where most of the students were from the Rai community and the teachers were from the *Bahun-Chhetri* community. This glimpse can help uncover hundreds of unspoken stories and thousands of unheard voices. However, I am not necessarily advocating a communal basis of teacher selection, that is, a *Rai* teacher for the *Rai* community, a *Bahun* teacher for his/her own community. However, I believe that the teachers should be prepared to listen to the many silent voices of local cultural milieus. In doing so, the teachers would be better able to make sensible connections between different forms of curriculum, such as local, national and global, and, thus orchestrate a role in the sense that Schubert (1986) suggests in relation to the nature of an *ecologically balanced*[14] (cf. connected) curriculum.

[12] Twenty-one is called Ekkais (/ekka:ɪs/) in Nepali.
[13] Bahun-Chettri/Chhetri-Bahun is generally, the name for the community of *Aryan* people.
[14] A curriculum that takes local cultural contexts into account.

In the second and third years of my schooling, Sukra's dilemma used to attract our attention. I did not count how many hours he practiced the number names and multiplication tables. However, one could easily infer that the words were powerless to him; the sentences did not bring any emotion to his face; the number names and multiplication tables were his enemies; and of course, he was number one headache for the teachers. Once, I noticed that he often confused *seven-times-seven-is-forty-nine* and *seven-plus-seven-is-fourteen* type of arithmetical statements: There was no remedy for that, as the metaphor of teaching as *doctoring* (Pimm, 1994) was absent. Perhaps, Sukra could solve day-to-day problems related to addition and subtraction operations. However, there were no problems related to his father's daily wages or his mother's saved money from the small agrarian shop. The mathematics book was different. It could not help solve problems outside his classroom.

There were many *Sukras.* The differences between their problems were a matter of degree only. Primarily, many of them had difficulty with *Sanskritised Nepali* that compounded with the language of *official mathematics*. Others, who had Nepali as their native language, also had difficulty with *the* mathematics. I was in the second category—the category of being privileged, the group of being advantaged and the group of being favoured. However, I had also the dilemma of understanding the textbook's language – the language of authors – that was very different from our day-to-day language.

III

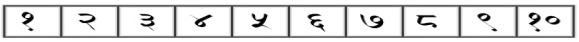
'Definition of Triangle'

"Why didn't you complete your homework? You pathetic...I know how to treat you. Oh...I forgot my stick…" I was stunned and tried to check whether I had completed my homework. The flat-long-moustache-faced person with a non-ironed suit and typical discoloured Nepali cap entered the fourth grader's classroom again. I could not make eye contact with Mr. Giant who was our opponent-and-umpire for the whole year's game. What a pity! We were a group of helpless opponents! He went directly to the small boy who was not able to complete 'math homework'. The boy's face was already full of fear. He was silently saying that he could not

understand the problem. However, Mr. Giant was too big to listen to the small boy's plea. A few days ago, the same boy was on the blacklist of Mr. Giant, and was threatened several times. He had said, " If you follow me, you will pass the test and become a good person otherwise you will remain a cowboy." At that moment, I looked at the boy whose head was shaking back and forth. However Mr. Giant's standard Nepali was too difficult to understand for that small boy.

In the Giant-dom, there was no place for our voices. Our quiet voices used to disappear in the kingdom of his mathematics. The definitions were his powerful weapons to contain our positions. The bookish problems were sacred texts and the process ritual was central. I had narrowly escaped from Mr. Giant's would-be punishments. Perhaps there were very few students who were still at large from his summons.
"If you tell me the definition of triangle, I won't punish you," Mr. Giant offered.
"A triangle is a figure with three sides and thee angles." It was the boy's answer.
"Your definition is not complete. I will give you one chance." Mr. Giant's moustache seemed to be shaking. However, the boy could not make it. He was so nervous about being punished.
"Now you have to go the front door, and from there you need to touch the left corner. Finally, you have to return here. Remember you have to walk on your knees. It will help you to remember a triangle as a 'closed' figure enclosed by three sides"
The small boy completed his 'job' seemingly with wounds to his two knees. However, I did not know whether he could insert the missing word 'closed' in his definition.

After graduating from the three-grade primary school, I joined the only secondary school of my village. Though it was a secondary school, it used to offer primary (grades one to five), lower secondary (grades six and seven) and secondary eduction (grades eight to ten). Situated a ten-minute walk from my home, the school had wider spaces, bigger buildings, and more teachers and students than that of my previous school. Mathematics was different in many ways – I had to use indo-Arabic numerals instead of *Devanagari*[15] ones; the mathematics textbook had three sections – arithmetic, algebra and geometry; and more importantly, my earlier experience of

[15] Devanagari numbers 1-10: 

learning mathematics—*listen-repeat-remember-recall*—was extended to another dimension, *do-what-your-teacher-says.*

The story titled 'definition of triangle' represents my fourth and fifth grade experience as a mathematics learner. I had developed the notion of geometry as a collection of definitions, facts and so forth. I still remember that I had memorized the point as *a geometric shape without any length, breadth and thickness*. However, I had experienced the problem that this definition could not help find the endpoints of a line segment. Similarly, in the case of angle measurement, I could not make any sense of why zero degrees and two right angles were on the same side of the protractor. In retrospection, the teacher could have used his arm to represent different types of angles. Even a *paper-made fan* could be a hands-on experience for us to identify and differentiate smaller and larger angles as Magina and Hoyles (1997) suggested: " to carry out certain widespread cultural practices"(p. 114) in order to improve spatial concepts of children.

My story further signifies that the *small boy'*s definition could draw a different genre of triangle—a hyperbolic triangle or trilateral (Figure 1) that may not be closed in the sense of Euclidean (flat) space. Most of our definitions became useless in the sense that they were linguistically and conceptually different from the teacher and textbook-generated definitions. In retrospection, there would have been plenty of opportunities for conducting alternative activities for developing the concept of triangle. Culturally relevant and thematically viable activities such as exploring different types of triangular shapes at home, school and in our milieus could have helped illuminate and extend this concept. Jean Piaget suggested that children's initial mathematical concepts mostly match the notion of *rubber sheet geometry*[16]. My experience suggests that this notion could also be extended to hyperbolic and many other (unknown) geometries. However, I witnessed that many *would-be* Lobachevsky and Reimann ideas were curtailed in the name of producing (cf. constructing) definition-based mathematics.

[16] A genre of geometry that deals with the notion of continuity rather than distance.

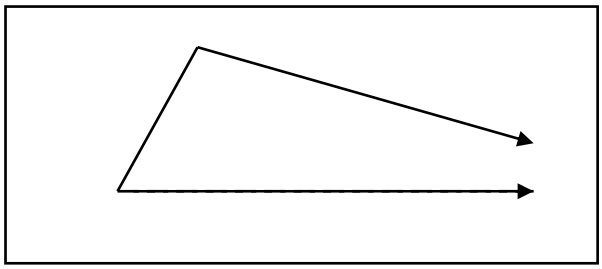


Figure 1: Triangle (i.e., trilateral) in hyperbolic geometry

Gradually and implicitly, I built the meaning of mathematics as memorizing definitions and *standard processes* suggested by the books and the teacher. *My world* and *our world* were just dreams—we were learning others' *dreamworld*. We had been prepared by and for unknown others. The way of learning was not much more different from Pavlov's classical conditioning, (mis)guided by the notion of punishment, based on the earlier version of Thorndike's *law of effect* (Bower & Hilgard, 1981).

IV

'Algebra and Me'

new mathematics/
but meaningless/
very few numbers/
but were useless/

x, y, z /
in place of one, two, three/
variable and constant/
someone's patent/
neither me nor mine/
neither we nor ours/
either they or theirs/

algebra/
on the wooden chalkboards/
in the books/
in our assignments/
searching for belongingness/

variably continues/
constantly accelerates/
but it arrives/
somewhere/
on an unidentified place/

'like' and 'unlike terms'/
unlike the numbers/
would be practical/
pairing same-sized shoes/
but 'hands on' were absent/
easier was monomial/
deadly binomial/
more unknowns in trinomial/
more 'pluses' and 'minuses' in multinomial/

addition as collecting/
combining/
subtraction as deleting/
taking away/
but adding '2a' and 'b'/
either 2ab or 2(a + b) or 2a + b/
taking away b from 2a/
an imagination beyond any basis/

Holding a view similar to Bean's (1995) claim that knowledge is integrated, I have tried to reflect upon my inward perception of algebra as a separate content area by raising three questions: Why was *the* algebra less sensible to me? Would there be any possibilities of making algebra more meaningful? What would help promote algebraic thinking, *algebra as a content* or *process*?

For me, there were some notable reasons that turned algebra into a less sensible content area. First, the presence of letters made conceptualising the relation between a numerical representation and a literal one a difficult task. Second, the nature of decontextualised generality embedded within the topic of algebra made it appear as a meaningless and vague content area. Third, as there was a need to develop a strong understanding of number sense, introducing (pure) algebra as a separate content area could not contribute to an holistic understanding of the algebraic process. Fourth,

two guiding metaphors, 'teaching as transmitting' and 'learning as receiving', turned the subject area into a *bank* of disconnected concepts and facts. Some of these experiences are similar with Kieran's (1997) observation of learning algebra and functions. However, her research setting is very different from my school and classrooms.

Utilising context relevant activities can help make mathematics more meaningful. Furthermore, use of culturally appropriate symbols other than letters can ameliorate the situation of disconnectedness between the content and context. For the first two years, intuitively, I used x, y, z as numbers but not as placeholders. So my problem was to differentiate between *x times x* and *x plus x*. The concept of square can be dealt with by the topic of area of geometric shapes and the latter can be discussed within any additive contexts, such as *two apples, two temples, two teachers* and so on.

Agreeing with the idea of Femiano (2003) that algebraic reasoning can be constructed in sensible ways "when approached in less sterile and more practical ways" (p. 444), my experiences indicate that the purpose of teaching algebra is: to make a vehicle for thinking rather than a (hard) content. Once, my teacher asked us to solve a simple equation x + 1= 5 by demonstrating a *model solution*. However, the model solution did not help me to solve 2x - 4 = 6 type of problem. As a content area, algebra did not help transform my ideas: instead it became another obstacle to extend my idea in order to develop the much-stated problem-solving ability.

Rural school, sacred mathematics and elite science

'Hopes and dilemmas'

January 1986
It could be any day of the first week. I was in my farm-home with my brothers. I could clearly see from the door of the east-facing room that the eastern horizon was so beautiful in the morning as if someone had poured purple-red colour on its giant body. The clear sky indicated a fine day—a day without any obstacles and perhaps with good news. I had woken up earlier. Perhaps a dream had awakened me. When does a day

start? I had asked this question to my father. He told me that, according to astrology, each day starts at midnight. Whatever is in astrology, for me, a day starts with sunlight, with morning and with a red-purple horizon because a fresh morning stands for hope and optimism.

Soon the sun came across the horizon and started its non-stop journey—a journey for sacrifice, a journey for generosity and a journey for mankind. "Had there not been the sun, the days would not exist, … we would not exist". I tried to substitute the science lesson on 'gravity' with a lesson on 'the sun'. Many possibilities were built on the axiomatic space of 'had there not been the sun'…

Dreaming about the imaginative world was over immediately after I remembered that our district-level external test results would be published within that week. I was sure that I would succeed. However, it was an external test. I had heard that other schoolteachers of the district were examining our answer sheets. Sometimes, I used to suspect whether the examiners would not be fair in marking our tests. I had not explicitly shown my rough working on the answer sheet of the mathematics test. If the examiner did not consider a complete answer-sheet without a rough part, he/she could give me a *zero*. On the other hand, remembering that I had solved all the test questions with required algorithmic steps—even, for some problems, I had explained how I had solved a particular problem—made me an optimist towards my would-be test result.

Time was endlessly passing – a common phenomenon of time. A short gathering after the morning meal among the neighbours was a common feature of that winter. In such an informal meeting they used to share their problems and achievements. What a rich context of a connected way of knowing! After that meeting one of our schoolteachers appeared in our front- yard.

"Namaste sir," was my greeting.

"Namaste. Do you know about your result?," he asked with a big smile.

"Not yet. Has it been published?," I re-questioned him.

He looked around the yard and asked about my eldest brother. I told him that he would be there soon. In the meantime, both brothers appeared from the nearby terraced-farm.

"… *sir* is asking about you," I informed both of them.

I was surprised by the arrival of the teacher in our farm home. If essential, he would visit our main home which was very close to his own place.

× × × ×

After being 'top' in the district level external examinations, primarily, I won a one-sided bet with my eldest brother. Once, I had asked him to buy a suit for me, but he told me that he would buy one only if I became district top in the seventh grade test. My schoolteachers were proud of me because it was also an achievement of the school after a long time of poor success. Some teachers had suggested finding a proper channel to get a scholarship to study in a good school preferably in the capital. However, nothing happened. Someone blamed the government channels and others criticised the local authority. One of the non-government organizations provided me with a reward as an encouragement.

Despite some hopes, the dilemma of not having a good mathematics and science teacher was making me depressed. I was familiar with the school's poor performance in the School Leaving Certificate (SLC) examination—a nationwide test for the successful high school graduates. If I could not study mathematics and science in grades nine and ten, I would not be eligible for the science course. I had not a big ambition—being a mathematics and science teacher was very important for me. Once, my eldest brother insisted that it would be good to be a government officer while my second eldest brother suggested that our country was in the need of a good leader, therefore, it would be good to aim at becoming a leader. I had said that I would be a teacher. I had not seen any engineers, doctors, and government officials. So being a teacher was a very prestigious job. However, I had foreseen many possible obstacles that could divert my ambition.

March-December 1986

I did not go anywhere. I continued my study in the same school. The head-teacher promised that he would try to find a good mathematics and science teacher even if he had to cross the southern border. The head-teacher wanted me to study in the same school because the school had to demonstrate a good result in the SLC tests in order to get government assistance. Parents and community people were also hopeful with the head teacher because he had brought many positive changes to the school in the short period since he had become the head teacher.

I had begun eighth grade with the hope that there would be a 'BSc teacher'—generally we had a perception that a BSc teacher would be appropriate for teaching mathematics and science. We had a myth that such teachers had to be brought from India otherwise from the southern part of our country. Generally the visible indicator of BSc teachers was their Hindi or Hindi-tuned Nepali language. However, the school could not manage to find a new mathematics and science teacher. The head-teacher told us, "We are sorry that we are unable to find a mathematics teacher for you. As you know we even tried to find teachers from India. However, we are trying to find one for your next year's science and mathematics class."
I had no options except to wait for a new teacher for the grade nine compulsory mathematics and optional science and mathematics.

Mathematics was becoming more test-oriented than in previous years. For instance, there was a practical activity given in the textbook for verifying the proposition of 'angle-sum-of-a-triangle-is-two-right-angles'. However, our teacher did not carry out those activities, saying that they would not be useful for our tests. Once, I explained in words why I performed particular steps for simplifying a rational expression in algebra. However, the teacher commented that such expression might lead towards a reduction of my marks in actual tests. Such comments helped frame my perception that there was no room for creativity in mathematics.

February 1987

I became a student of grade nine. I had to pay more attention to my studies. I had heard that our head-teacher had convinced our old science-math teacher, who was teaching in a different school, to return. I had no idea why he had left our school—perhaps because of our previous head-teacher's indifference towards the betterment of the school, or lack of additional allowances, or other personal reasons. However, there was a challenge to convince other students to make a sizeable group for optional subjects. Otherwise, that opportunity would be lost forever.

Formally, we got a BSc teacher—a familiar person with a north Indian or south Nepali face. On the first day, there were more than 15 students in the optional mathematics class. He introduced trigonometrical ratios by

insisting that we memorize those ratios so that we could use them in further exercises. He also suggested that there would be more than 200 formulas to remember. "Compulsory mathematics is easier than this. Even science is not a problem," he commented.

Next day, two thirds of the students moved into another optional subject group. We were only five in that group. It was a clear indication that the number could be down further to one—I was committed to study optional mathematics and science. On that day, the teacher did not teach properly. He discussed his plan for finishing all course (including grade ten) by the end of that year so that we could better prepare for our SLC test. We did not say anything except for shaking our heads.

Thereafter we never saw the teacher again. Some School Management Committee members said that it was too late for the school to find another teacher. So I had to choose other subjects. It was a big setback for me, as I could not study mathematics and science. What would that imply? Was there no possibility for me to be a mathematics teacher? What would happen to my dream of being a mathematics teacher? There were many unanswered questions for me: it could be true that life is unplanned and chaotic. Only one option was left: to expect a set of unexpected events and occurrences from my future.

February-December 1988

It was my final year in that school. However two 'iron-gates' were ahead—one was the *sent-up test*[17] and the other was SLC[18] examination itself. There was not a big problem in my studies. However, I was often sceptical about the formulas, proofs and theorems of compulsory mathematics. Whilst my mathematics teacher started to write a sequential set of proofs for a theorem about the relationship between a diameter of a circle and the perpendicular drawn to it from the centre, I told him that I did not understand the theorem. The teacher could not explain more than what was written in the book. Next morning, when I saw the head teacher—he used to offer me a free tutoring English class every morning — I told him that the mathematics class was not going well. Soon, his face changed. He replied reluctantly " He has been brought by…. How can I complain?" After this, I started to become more vocal in mathematics classes than I was in the previous classes. Very hot

[17] A qualifying test for SLC examination.
[18] School Leaving Certificate

discussions took place about the formula of finding the area of a handkerchief without the given rectangular border. " It is common sense that we can find the area by subtracting the area of the border from the area of the surface covered by the whole handkerchief. Why do we need formula?", I contended. The teacher's face clearly reflected that my arguments were offensive to his authority.

"Do you think that the book writer is a stupid person?," he re-questioned. The author and the textbook were powerful masks to make him safe. If it was now, I would certainly say, " The book author is stupid in the sense that it has not been written for my place: instead, it has been written for the capital and other city areas where electricity and cement buildings are available." There were many occasions that I tried to discuss more about the how part of theorems, formulas, and mathematical operations. Nevertheless, the teacher never put himself in the same communicative space with his students; instead he tried to situate himself somewhere 'above' to protect himself.

The unresolved problem of language was still there. One of my friends, *Youddhihang*[19], told me about his problem of not being able to solve the bookish problems. Especially, when he asked me to help him translate word problems into an appropriate mathematical statement, I found that he was not making sense of the Nepali-worded problems. He also shared his dilemma with me that he had to work to earn the tuition fees[20]. The following piece of a poem can represent his perception of being in the school.

being in the school/
very much similar with/
being in an unknown place/
with unknown people/
with unfamiliar language/

with unusual rules/
perhaps I will be turning into/
converting myself into/
a mass of senseless being/

being in the school/

[19] A Limbu name—Limbu is an ethnic community of eastern Nepal
[20] In my time, only primary education was free.

could not help my parents' work/
could not support my brother and sister's learning/
could not help think better than then/

I had asked a friend of a neighbouring school about his BSc teacher and science and mathematics classes. Unfolding a different story about his science teacher, he said that the *India-educated* teacher could not speak Nepali nor could he make sense of what he was doing in the Nepali classroom where most of the students' native language was other than Nepali. My friend's experience with the teacher was horrific, as the teacher did not have very basic concepts of physical science. He also told the story that a BSc teacher of … school had to leave the school after being unable to produce the relevant certificate to the authority. Finally, my friend admitted, "We are in big trouble now. We cannot change our subjects nor can we expect a good score in the SLC test." Listening to my friend's dilemma gave me a petite pleasure for not choosing mathematics and science.

Grade ten finished. It meant that I was ready for the SLC test. There were some fresh hopes just like a morning. However, the dilemma was still there--what would I study to become what I had envisaged four years ago?

The sequence of my autobiographies represents the transitional context of entering the secondary level of schooling and moving ahead with various hopes and dilemmas after being successful in the grade seven district level examination. My earlier 'horrible mathematics' was improved a little by the middle of sixth grade, in the sense that I could memorize and apply the formulas and facts for the bookish problems. Improving mathematics was to be able to find the answer of the problem by following the *right method*. I *did* enhance my ability of using such mathematical knowledge and skill in my home—especially, I learnt algebra with my eldest and second eldest brothers—rather than in the school. By saying so, I must suspect the function and usefulness of our schools, especially for children who belong to a lower socioeconomic background and have illiterate parents and siblings.

Studying in a resource-restrained school was a big dilemma for me. However, you may think that I am becoming so personal and selfish that I do not take into account the majority of high school students' learning conditions—they did not have as many

facilities as I had. Perhaps, you agree with me that having a dream to be a mathematics teacher was not a selfish act. However, I had not read the stories of successful teachers nor had I read the stories of bad teachers. My eldest brother was my initial ideal. Later, I implicitly constructed the image of my *would-be* future profession by embracing various qualities of my other schoolteachers. I had also read about the role of *Dronacharya*, *Durwasa*, and *Biswamitra*[21] as teachers. However, I did not like *Dronacharya's* biasness toward a non-royal disciple and *Durwasa's* unnecessary anger: instead, I was very much impressed by *Biswamitra's* notion of *good-deeds-are-the-means-of-achievement*.

There may be different arguments about the status of science as an optional subject in the secondary school education. From an extreme position, you can argue that making science an optional subject could help promote elite-interests that science should be accessible to a certain part of the population. Perhaps, this situation leads towards a classification of the students into privileged and 'Other' (Giroux, 1993). Speaking from a moderate position, you might agree that making science an optional subject could reduce the government's burden of providing all secondary schools with science teachers and science equipment. In the context of a severe lack of locally trained science teachers, the decision of making science an optional subject could also be a wise step for making an alternative pathway for rural students. In essence, in light of these issues you may agree with Wood's (1988) idea that curriculum decision and implementation is a political process.

Substantially, my activities as a disinterested student were in the direction of breaking the existing culture of silence. From one perspective, it was a natural attitude, as educational psychologists suggest that one of the characteristics of young adults is to suspect hypotheses and formal procedures. On the other, it can also lead towards the development of anarchic attitudes towards existing norms and values. In my experience, this is the stage of developing foundations for critical thinking which can be promoted by creating an "atmosphere of tolerance for the diversity of approaches to a problem" (Volmink, 1994, p. 58). Furthermore, opening other avenues for algebraic and geometric activities can create a context for discursive and

[21] Hindu sages (e.g., *Rishis*).

dialogic activities. Using algebraic skills in order to solve real-life problems can be a transformative pedagogy. Even in the case of purely algorithm-based content, a dialogic classroom would be far better than those monological and textbook-oriented classes.

Making 'school mathematics for all' has been a central issue in mathematics education for more than three decades. *Youddhihang's* dilemma of not being able to solve word problems can be a challenge for making inclusive mathematics. Some researchers have argued that the unique lingual and representational bases can be a reason for mathematics being a difficult and decontextual subject. Pinxten (1994) clarifies the issue of mathematical language from an anthropological perspective:

> Indeed, the commonly used mathematical language has a structure that is decidedly that of the European languages; it distinguishes clearly between things (classes, categories, sets, etc.) and operations on things (sum, division, etc.). The 'view on the world' which is implicit in mathematical knowledge corresponds to a large extent of that of the ontology of the Westerner; reality consists of things (subjects, objects situations, etc.) and actions or events vis-à-vis these things (movement, change, etc.) (p.91).

What does this indicate? Can we uncover multiple ways of representing mathematics? Could my teacher explore multiple approaches to mathematical representation?

Power, democracy and mathematics

'We Have The Power/We Do Not Have The Power!'

'Episode 1'

It could be any day of the second week of March 1990. Mr. Scorn used to be ten minutes late. This was a clear signal that he was trying to make us leave the mathematics group. "If we accept Mr. Scorn's irresponsible behaviour we will be the sufferers", Prakash continued. "Look, last week he was absent without any explanation. We need to do something."
"That's true. If we remain silent, that will help Mr. Scorn," Mohan broke the silence.
"I also agree with this idea. But what can we do? Can we report again to the campus chief?," I added my opinion.

"Don't worry my friend. We have the power. You know the student movement is getting stronger and stronger these days. We need to be ready for our major struggle against the autocratic regime of Mr. Scorn," Kranti made a 'lecturette'.
"Let's plan something concrete. This situation is like we have power/we don't have power," Tanka tried to summarize. Finally we agreed to write our problems and submit them to the campus-chief. However, Kranti was still arguing for a major movement against the old regime. He frequently commented that the campus chief is a representative of the old regime; therefore, he would not take the initiative to solve the problem. He further said that only a storm-like student movement could compel the old regime's followers to accept our demands.

'Episode 2'

It could be the third week of March 1990. We were in front of the campus-chief. We handed him the paper we had prepared. He skimmed and asked about the solution of our problem. Kranti was going to say something but we stopped him. We proposed collectively that it would be better if he would provide us with another teacher. He did not promise anything: instead he advised us not to come under the influence of 'anti-national forces'[22]
"You see the campus chief is the *dog* of the autocratic regime. He would not help solve the problem," Kranti interpreted.
"Let's wait and see," I continued, "If it did not work we would think differently."

'Episode 3'

Next day, Mr Scorn appeared at the right time. We interpreted it as an outcome of our move. We smiled and shook our head. Mr. Scorn wrote two first-degree equations and asked us to find the intersecting point. We all, except Tanka, could do it. However, the mistake was due to Tanka's haphazard calculation. Mr. Scorn told him that he would be quite happy if Tanka left the mathematics group.
He then wrote another problem from the topic of locus which he had not taught yet. The problem was to find the locus of all points that is equidistant from a central point. Kranti and Prakash could not do it. He laughed at them and said that it was very hard for them to study

[22] The political parties and their activists were labelled as anti-national forces by the non-party system.

mathematics. Kranti became angry and told Mr. Scorn "Why don't you teach properly the concepts and tell the way of solving problems?"
"This is a campus, you know? You have to be responsible yourself for your study?," Mr Scorn tried to mask his real interest.
"We are not asking you to do our homework. We know that. But have you ever thought about your responsibility as a teacher?"
Finally Mr. Scorn became so angry that he had no recourse but to leave the classroom. It was our mini-victory. He suddenly stopped appearing on campus and in our classroom.

'Episode 4'

It was the first week of April 1990. There was no sign of regular classes. The mass movement was spreading all over the cities and campuses. Rumours were taking place that some teachers who were supposed to be the movement's supporters were under surveillance. We did not see Mr. Scorn for two weeks. We continued our earlier group-learning process by exchanging ideas, books and whatever we thought was useful. In the meantime we met a former student taught by Mr. Scorn. He told his horrible experience as follows:

> He rarely comes in the classroom
> If he comes, he will not stay the full teaching hour
> If he stays the full teaching hour, he never teaches all the time
> If he teaches, he does not make it understandable
> If he makes it understandable, he does not complete the course
> He completes the course only if you attend his private tutoring

'Episode 5'

After a week-long national celebration for gaining democracy, our class resumed again in the fourth week of April. Mr. Scorn started to come on time. He continued the topic of the equations of straight lines. He finished the topic in forty-five minutes by writing all formulas and solving two or three problems. When I said that I could not understand how the equation was rewritten into a slope intercept form, he replied that that question was too easy to ask. Then, we all collectively requested him to explain in simple language what he had done. He did it but uncomfortably and incompletely.
We experienced some impacts of the newly declared democratic system. Mr. Scorn had started to listen to our voice regardless of his attitude.

'Episode 6'

It could be July/August of 1990. By then, Mr. Scorn had changed his earlier metaphor of teaching from one-way-talking to dictation. That was a little better because we could be able to have a record of what we studied on a particular day. However, most of the definitions and problem solving techniques hardly made any sense to me. Once, Mr. Scorn was solving a problem related to the centroid of a triangle. Mohan asked Mr. Scorn, "Excuse me sir, what does the term centroid actual mean? Is there any Nepali word for it?" Mr. Scorn could not say then that Mohan had to leave the mathematics group.
"You need to memorize every definition, formula and problem solving style I have written for you."
Mr Scorn's answer entered my ear as an arrow.
Mohan tried to be particular that he did not understand the definition of centroid. He insisted that the teacher explain what centroid is. Mr. Scorn tried to generalise that we had to memorise the definitions so that we can understand better.
"But our psychology teacher says understanding of learning can be improved by meaningful learning. If you explain in Nepali we can make sense of it."
Someone said these sentences.
"Mathematics and psychology cannot go together. You need to know the formulas and definitions otherwise how would you pass the test?"
He masqueraded his earlier stance by bringing in the term "test".
Mr Scorn's thick lips were moving. " I don't have any idea that centroid can be explained in Nepali," He again put on another mask. He further said, "Perhaps you need to improve your English so that you can understand mathematics." In the meantime I remembered that one of my English teacher's comments on Mr. Scorn's dictated notes that many sentences did not make sense to him either. Then he commented that Mathematics English would be very different from common English.

These episodes portray the context of mathematics classes in my first year of the Intermediate course, after being successful in the SLC examinations. Why did I choose mathematics? Why did not I switch to other subjects? Perhaps, the prevailing power of mathematics and mathematics teachers made me opt for mathematics as a major subject. Would it mean that I would become another *Mr. Scorn*?

Reflecting upon the concept of power results in three major often-blurred dimensions: the political dimensions, the cultural dimensions and the personal dimensions. By making distinctions, I am not trying to cover other emerging themes of this area. Nevertheless, it is my tentative explanation of how the political dimension was dominant in shaping and restraining our ways of learning; how the cultural dimensions became a corollary of the political system; and how our personal dimensions tried to both confront and adapt to the situation. The topic of linear equations was a means of making us loyal to a particular system or group or person. There was nothing intrinsically wrong with the concept of centroid: instead, the teacher's lecture as a conduit for his knowledge was a clear obstacle for making us liberated learners. In retrospection, the centroid was not there: rather it needed to be brought into the context.

In the context of my experience with the symbolic power of mathematics, there was plenty of groundwork to achieve that. For a student who came from the context of a segment of society that relied on manual and non-scientific technologies, various aspects of symbolic power were yet to be conceived. Furthermore, as the uncritical curricula and pedagogy *did* focus on the symbolic representations as unchangeable entities, the power of the mathematics was lost somewhere. Put simply, the symbols were made so dry that there were no *lives*. In my experience, there may be a danger in diverting the power of symbols to the power of someone. In essence, being cautious with the much-aphorised notion of symbolic power I quote the voice of Pierre Bourdieu from Skovsmose (1994) that

> people speaking local dialects are induced to collaborate in the destruction of their own means of expression; in this case education adopts the aim of imposing a new language, the official dialect as the standard of education (p. 56).

In my experience, Mr. Scorn tried to masquerade his position by using two basic myths, such as *cold reason* and *hard control* (Taylor, 1996). Subscribing to decontextualised reasons (Wakerdine, 1994) and regarding them as absolute truth was putting us in such a frame that we would view mathematics as a collection of sacred texts. Similarly, the second myth, hard control, was not created only by Mr. Scorn; instead, it was a part of our curriculum process. The process of curriculum

decision-making had envisaged a very limited role for our voices. By default, we were required not only to listen to the other's voice but also to regard it as an undeniable truth. My reflections are not aligned with the goals of making anarchic pedagogy. Rather, I agree with the ideas of Wood (1994) that

> the expectations and obligations that are established between the teacher and students act to create a culture in the classroom and as such the essence of the setting in which [students] learn (pp. 151-152) .

Some changes seemed to be taking place in Mr. Scorn's behaviour after the dawn of democracy, yet those changes were to be sustainable and substantial ones. However, the change was a clear indication that any education system could not be independent of the contemporary political system. Starting to come into the classes on time and trying to listen to our voices were some notable changes of Mr. Scorn. Nevertheless, in the case of his pedagogy, a substantial transformation was yet to take place. The traditional ethos was still there: to govern us by putting on a mask that many mathematical concepts were difficult to bring into our local context.

An integral reading

Reading my impressionistic autobiographic vignettes, *We Have The Power/ We Don't Have The Power*, from an integral perspective may help understand the prevailing tensions between *utilizing power* and *misusing power* in our teaching-learning milieus. Utilising power can help establish the *locus of control* in a classroom in which a teacher and his/her students can act according to pre-determined classroom dynamics. In my experience, classrooms with the locus of control as activities are helpful for creating a participatory learning environment. In such classrooms, students may make sense of what they are learning and being taught. However, making *decontextualised text* (e.g., subject matter) as the locus of control makes the teacher powerful because the authority of the subject matter does not lie with the students.

There may be some arguments that a teacher needs to exert a degree of power to create a conducive learning environment. This argument can lead us to open the genres of power we exert in the classroom. Do we use power to make students

powerful learners? Or, do we use power to make students powerless knowledge receivers? Making students powerful requires teachers to be well prepared in both pedagogy and content. In my experience, teachers often face difficulties in articulating subject matter to make it learnable for their students. As a result, they may choose the easiest path of suppressing students by holding the *whole power*. For me, teachers who always try to hold the power themselves are actually *powerless*: They may have a fear that they will lose it once they give it to students.

Perhaps, we do not intend to create an anarchic classroom. A powerless teacher and a chaotic classroom do not help students achieve their learning goals. This opens a new avenue of searching for relationships between 'using power' and serving different types of *interest*[23] (Taylor & Campbell-Williams, 1992). Serving students' interests is to use power to help their learning. Similarly, '*when and what-type-of-power is to exert'* is very important for a teacher in his/her day-to-day teaching-learning activities. However, what may not be the best use of power is to use it for the justification of teacher-imposed activities. Our students can be made responsible for learning by involving them into planning and assessing their (teacher's and students') own learning activities. We may agree that power sharing is far better than power imposing. Let us exert power to transform our students' learning rather than to restrain their thinking!

[23] Technical, practical and emancipatory *interests*.

CHAPTER TWO

CONSTRUCTING MEANING FROM MEANINGLESS MATHEMATICS

Pseudosphere[24] and Nepali Shanai[25]

'Hyperbolic Geometry in *Nepali Theatre*'

(A one-episodic (?) stage drama)

('Matheature' was already full with expectant audience waiting for the recently advertised drama on 'Shanai and Pseudosphere'. They did not have to pay a large sum of money for a ticket because some international donor agencies had provided technical and financial support for this alien show. Whilst some of the audience started to be vocal, the director of the drama began making announcements from inside the unopened stage.)

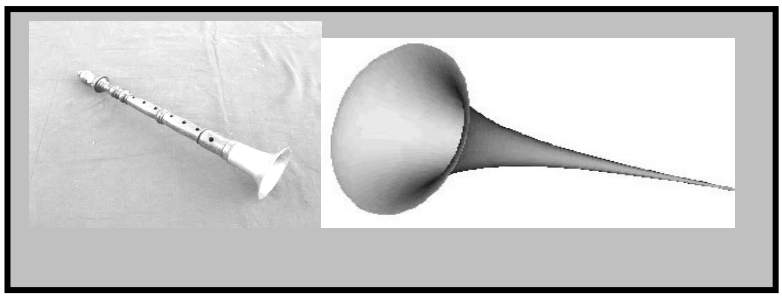


Figure 2: Nepali Shanai and (the upper half of) a pseudosphere

Director: Hello, hello… (Gentle cough). I am today's director. Our artists are almost ready. However, we have a technical problem with the pseudospheres. They were fine until yesterday but some of parts have been found to be broken today. Our mechanic is working on it. Hopefully, it will not take long. I would kindly request our respected audience to be patient for a few more minutes.

(Time is running out. The audience is full of noise. No one has any idea about what is happening behind the stage. Again, the sound

[24] The surface of constant negative curvature generated by the revolution of *tractrix* (i.e., a type of curve). This surface corresponds in non-Euclidian space (i.e., *hyperbolic*) to the sphere in ordinary space.
[25] A Nepali musical instrument resembles pseudosphere.

system gives an indication that someone is about to announce something.)

Deputy-director: Dear audience, the pseudospheres have been fixed. It took a while because our mechanic was trained for spheres. We did not have enough time to invite a qualified mechanic... I am your, oh sorry not yours, ... the drama's deputy director.

(With this announcement, most of the audience has guesses that something is going wrong with the planning of the drama. However, they are ready to wait until midnight. Whenever the curtain starts to shudder the audience focuses on the stage as though the drama is being presented in front of them.

A couple of hours pass. The audience is planning to get a refund. In the meantime, the loudspeaker is turned on. The audience becomes cautious as a familiar person starts to make an announcement.)

Director: Respected audience, we are going to start our drama soon. Before we start, I have to apologise that we are no longer able to demonstrate the much-advertised five-episodic drama.

(Gentle noise from the audience.)
… Our artists seem to be exhausted because of continuous rehearsals. Similarly, we still have some technical problems with the pseudospheres. Despite these difficulties our artists will try to be more educative than in their previous performances.

(Slowly, the stage-lights are turned on. The background music is saying, " …We need to change our thinking. We need to change our society with the help of the knowledge we have acquired." Gradually, the dark green curtain starts to move. The stage seems to be a classroom with 10/12 students. The audience applauds. Within a minute, an actor in a teacher-like outfit appears on the stage.)

Students: Good morning sir.
Dr. Euclid: Is it really morning? Oh, I thought it was evening. Anyway, good morning to you. Do you have any idea about our lesson today?

Students: Yes sir. We have to perform a drama …oh no, to study about the pseudosphere and the Nepali *Shanai*.
(In the meantime, whispering voices can be heard. The director is saying something from behind the stage. Perhaps, the actors have forgotten their first dialogue.)

Student 1: Sir, how is the pseudosphere similar to the Nepali Shanai?
(The student shows a pseudosphere (Figure 2) to the audience. The audience becomes exhausted by the lack of dramatic quality of the artist.)

Student 2: Don't show this outside the windows! Why don't you realise that you are in a classroom?

Student 1: Oh no, we are not in a classroom. We are in a theatre. Don't you know this?
(Someone switches off the loudspeaker. The curtain starts to move and the director again makes announcements.)

Director: Dear audience we have just finished *part one* of the scene. Our artists are very different from others. Let's start part two.
(Curtain opens…)

Dr. Euclid: Guys what happened to you? (Yawning) Let's start our lesson for today. Our topic is hyperbolic geometry… Any idea about it…?

Student 3: Yes sir, it is an alien geometry. But I have no idea why you gave this to me (showing a Shanai)?

Dr. Euclid: I will explain. There are plenty of weaknesses in Euclidean geometry. Euclid defined everything including the point, line and other mathematical objects. However, it is very difficult to make sense of those definitions. …(He continues his lecture.)
Hyperbolic geometry was developed by a Russian mathematician, Lobachevsky. However, it is a result of many mathematicians' efforts to prove Euclid's fifth postulate[26].

Student 4: Why don't you speak slowly so that we can make a brief note of this? (Other students also support the idea.)

Dr. Euclid: Ok. I will give you that tomorrow. I will continue my talk on hyperbolic geometry. It has strange types of parallel lines, which meet if extended. Similarly, the angle sum of a triangle is less than two right angles. What else? The proof is also difficult compared with a Euclidean one. It is open and does not have any specific steps for theorem proving. Very difficult indeed!

[26] It can be stated thus: if two lines are drawn which intersect a third in such a way that the sum of the inner angles on one side is less than two right angles, then the two lines inevitably must intersect each other on that side if extended far enough. In other words it is also known as the '*parallel postulate*'.

Student 3: (Showing a semi-pseudosphere and a Shanai) Why did you ask us to bring these things into the classroom? It is too hard to carry both these objects in our hands…

Dr. Euclid: It will take a while to explain these objects. Let me finish first some fundamental issues of hyperbolic geometry. More than one parallel line can be drawn from a given point to a given line. This is the main thing you need to put in your mind…

(The stage is gradually turning into a lecture-theatre. The audience faces a big dilemma of whether to leave or stay because of the meaningless lecture (for the audience) of the teacher-turned-artist.)

Director: (murmuring) What are you doing? Did you forget the new method of acting? (The director murmurs continuously. Most of the audience is being entertained by watching the drama of the artists rather than the actual drama. For the moment, the teacher-turned artist goes behind the stage and appears with a small notebook.)

Dr. Euclid: (Opening the notebook and pointing to a student) Who developed the hyperbolic geometry?

Student 5: I don't know. I guess that the person who first invented this instrument (Showing a Shanai) also developed hyperbolic geometry.

Student 3: But this is different (Looking at the model of the upper-half of the pseudosphere). There are no holes like this (showing a Shanai).

(The teacher repeats the same question to all the students. Only one student can produce the correct answer. The class seems to be chaotic in that every student is busy on their own. The director warns the artists to focus on their dialogue about the much-waited subject of Shanai and Pseudosphere.)

Dr. Euclid: Guys, I hope that you remember the important facts I told you today…

Student 4: (Interrupting) Excuse me sir, what is the use of this alien object (pointing to the semi-pseudosphere)?

Dr. Euclid: You know, it is the plane for hyperbolic geometry. This (showing a sheet of paper) is a flat space which has been embraced by Euclidean geometry.

Student 6: I did not get one thing. What type of notebook/paper do we need to use in this geometry? Are there any hyperbolic pages? (Laughs from the audience)

Dr. Euclid: I have no idea about that. My teacher told me that the Shanai could be a useful plane for hyperbolic geometry.

Students: Oh, that is interesting.

Student 6: Which part of the Shanai can be regarded as a hyperbolic plane sir?

Dr. Euclid: (Opening his diary…) Oh it is not here… Where have I written that? Perhaps, I don't have an answer. You know, the director… sorry, my teacher told me that a Shanai resembles the upper half of a pseudosphere. At that time, I had not seen any pseudospheres nor had I compared them with a Shanai.

(Students seem a bit confused about the topic of the class, so does the audience. Some of the students go behind the stage and appear with their diary. The teacher seems busy opening the pages of his diary. The stage remains uncontrolled for a while. After a sharp whistle, the dark-blue curtain is closed partially in order to hide the chaotic scene on the stage. In the meantime, the director appears on the opened section of the stage.)

Director: Respected audience, I hope that you have been entertained today. I must disclose that the new 'method of acting' has been imported from a friendly overseas country. Perhaps, our artists got lost sometimes. It can happen at the beginning. Our main purpose is to inform you about the relationship between the new types of mathematics and our cultural artefacts. In my and the director-general's assessment, this drama will be a milestone in the history of Nepali theatre, and will help implant new ideas in our and your heads. Finally, I request you join with me to thank our artists for such a wonderful job…

(Applauds. Curtain closes)

The drama, *Hyperbolic Geometry in Nepali Theatre*, depicts some of my experiences as a first-year student in my bachelor's studies. By then, some of my earlier conceptions of university classes had been modified. One such modification was to construct a new intention – to achieve the degree. So, collecting old test questions, rewriting teacher-dictated notes, and memorizing definitions were my routine activities. While doing so, my *would-be* image of a mathematics teacher was gradually transforming into a *bank* of discrete facts and disconnected concepts. I projected my voices through student forums, newspapers, magazines and other

formal and informal media. However, these voices of mine rarely had any connection with the mathematics I was studying. In retrospect, mathematics had been situated very far from my day-to-day theatre of life.

Non-Euclidean geometry was not an exception. Initially, I had more enthusiasm in this subject than in higher algebra, two- and three-dimensional geometry, statistics and so forth. When I heard for the first time that, in hyperbolic geometry, parallel lines meet if they are extended, I murmured myself, “It will certainly be of interest to me”. Perhaps, I was interested in non-Euclidean geometry because of my dissatisfaction with the conventional mathematics.

However, my image of non-Euclidean geometry was shattered, as I could not figure out any fundamental differences between Euclidean and non-Euclidean geometry in terms of teaching methods. Non-Euclidean geometry was presented as a difficult subject because it did not prescribe any specific steps for proving theorems. As a student, following a closed and uncritical path was safer than embracing the critical and open nature of non-Euclidean geometry. In essence, I was accustomed to being a receiver rather than a constructor of mathematics.

You may be eager to know about my some of the experiences in ‘non-Euclidean classrooms’. Initially, I could not make any sense of why Euclidean geometry has some *logical shortcomings*. I did not have any prior knowledge about this notion. The historical background of hyperbolic and other non-Euclidean mathematical traditions was interesting. However, the subject matter had been disseminated as though it was another canon of knowledge which I could not explore from my context nor could I ‘receive’ easily. “Where does the hyperbolic geometry work?,” was my regular question. I could not remember our teacher introducing the plane of hyperbolic geometry at the beginning of the topic. While discussing the notion of *trilateral*, he told us that it is possible to draw a trilateral on a (semi)pseudospherical plane. What does this imply? Were we not studying hyperbolic geometry on the axiomatic plane of Euclidean geometry? For instance, the teacher used to draw hyperbolic parallels—they are intersecting lines in Euclidean geometry—on the Euclidean plane (without any reference to a hyperbolic plane) and label them as

parallel lines. So, for some years, my understanding of hyperbolic geometry tended to be a meaningless mass of knowledge.

At the end of the topic, many of us asked our teacher about the nature of a pseudosphere and its availability. My short-term perception of hyperbolic geometry, as a superficial and disconnected body of knowledge, was challenged slightly when our teacher replied, "My teacher said to me that a pseudosphere resembles the Nepali *Shanai*". Although he tried to familiarize (was that contextualisation?) us with the complex body of knowledge by that example, it was not sufficient for me to understand hyperbolic geometry in my context. Furthermore, only reciting that the Shanai is similar to the pseudosphere did not establish a connection between hyperbolic geometry and our culture; instead, it only seemed to trivialize the practical aspects of hyperbolic geometry.

When read about Jerome S. Bruner's (1966) *guided discovery* approach in mathematics learning, I was convinced with his statement that any subject matter can be taught (and learnt) effectively if it is presented in an academically honest form. Does this statement make sense in the context of my experiences of hyperbolic geometry? For me, Bruner's notion is related to teaching method and organization of subject matter. In my experience, the structure of curricula and textbooks had a considerable impact on student learning. However, a successful teacher can reorganise subject matter into a learnable (cf. academically honest) form. Perhaps, conducting in-depth studies about the *Shanai* and other cultural artefacts in relation to their viability and vitality for representing different mathematical planes can help contextualise non-Euclidean geometries. In essence, exploring mathematics in our cultural artefacts might have encouraged us to explore an academically honest form of mathematics for Nepali students.

I have modified my perception of hyperbolic geometry from time-to-time. At the beginning of this project, Peter told me that non-Euclidean geometries could offer alternative worldviews (Davis & Hersh, 1981). This realisation sensitised me to reconnect my experiences with possible alternative worldviews in searching for Nepali mathematics. In doing this, first, I have tried to stand outside the

Lobachevskian hyperbolic frame (being the audience in general), and view my (cf. your 'the readers') *learning experiences* of that subject. Second, I have reflected upon my experience within (being a student-actor) that frame. It is again a crucial time for me to raise the same question which I had asked myself before: What does it mean to be a mathematics teacher? I may need to select one or both of them: amassing senseless subject matter in order to be a conduit of content or reflecting upon the self's situatedness in order to be pedagogically wakeful. What do you think about these choices?

Rethinking subject structure and pedagogy

'A letter to Michel Rolle[27]

Dear Mr. Rolle

I would like to extend my warm greetings from the land of Himalayas. I hope that you are fine and busy creating more mathematics for the people who reside up there. Perhaps, Newton and Leibnitz also have introduced the subject of calculus to enrich heavenly peoples' ideas. Did they fight again? Leibnitz may have been more successful in introducing his ideas and symbols because he departed from here eleven years earlier than did Newton.

I am a mathematics teacher of Nepal. Perhaps, Nepal was an unknown place during your lifetime. Interestingly, while you were exploring your mathematics, my ancestors were busy explaining the area of oblique triangles for their astronomical explanations. The work of my ancestors disappeared from the public domain (i.e., publishing) whereas your well-documented theorem[28] arrived here to 'change' our (anthropomorphic) misconceptions of change, function, slope, and tangent, and so forth, to scientific concepts.

Dear Rolle! There are two purposes for writing this letter. First, I would like to share my experience of your theorem, which I did not understand for many years (Still, I suspect myself). Second, I would like to share my

[27] A French mathematician who is famous for his theorem called Roll's theorem Born: 21 April 1652 in Ambert, Basse-Auvergne, Died: 8 Nov 1719 in Paris, France.
[28] If $f(a) = f(b) = 0$ then $f'(x) = 0$ for some x with $a \leq x \leq b$.

experience of how the theorem would be constructed differently for my context. By reading my letter, it may be easy for you to prepare another version of your theorem for prospective Nepali teachers and students.

When I started my second year of a bachelor's degree course, I found that your theorem was the main topic of my course of study. However, the name 'Roll' did not resemble a French name, instead, it was an anglicised name. Your theorem was not in your language nor was it in my language. Perhaps, you have no problem with the conversion of your name and theorem to English because of the prevailing similarity between the ontological ground of your language and the English language. Though I could understand the meaning of the words mentioned in the theorem, it was very hard for me to contextualise the meaning of your theorem. Perhaps, you studied under the trivium and quadrivium system of liberal arts, and that enabled you to implant the notion of knowledge-as-independent-entity-to-the-knower. So, you might suggest to me that your theorem is accurate because it has a rational proof irrespective of the context. Did you meet Giambatista Vico[29]? He could suggest some alternative ways of dealing with the nature of knowledge. Perhaps, you will contact him after receiving this letter. I hope that (after meeting him) you may find that your archaic notion of learning and knowing needs to be accommodated by his views of learning. However, I would not suggest that you try to change your experience of being influenced by your earlier view of knowledge. We cannot replace our previous experience by a subsequent one. If so, I would replace my negative experience of learning your theorem with the positive experience of a constructivist way(s) of knowing.

I am not challenging your theorem. However, I am helping you to understand my (cf. our) problem. When I read your theorem, I became lost somewhere in the continuum of your given facts and your to-be-proven-part(s). Perhaps, the axiomatic model, which you had used, confronted my system of thought. I did not (do not) know about the type(s) of system of thought I had (have). However, I can say that my system of thought is a part of my cultural capital which is not easy to replace (cf. extend) by any other thought process. From a utilitarian perspective, your theorem was only useful for me later to teach other 'student teachers' in the way I had been taught. Despite being machines of reproducing your theorem, we may never know the intention of this

[29] An eighteenth-century philosopher who questioned the nature of knowledge as an objective entity.

theorem in the context of developing mathematics teachers for the secondary schools of Nepal.

You may feel challenged because of my dissenting views on authorship. Perhaps, the idea of authorship was more important in your time than at present. Still, many people hold the view that authorship makes it easy to organise and represent knowledge (cf. knowing). However, I would like to raise some questions: How is it possible to make the same understanding as the author? Does it not imply that authorship is meaningless and does not solve the problem of contextualisation? Let's take an example from your theorem. How would you guarantee that my interpretation (even my teachers') of your theorem is similar to yours? In my experience, the traditional notion of authorship made our teaching-learning process seems like a series of reproducing another's ideas.

You may ask me to suggest an alternative solution for this situation. I am not an anarchic person in the sense that everything should be dissolved. However, I hold the view that the taken-for-granted notion of authorship needs to be reviewed critically in order to transform mathematics from a non-humanistic knowledge container to a humanistic enterprise. Some years ago, one of my students asked me: "Is mathematics superior to mankind?" I would like to pass this question on to you.

In this final paragraph, I would like to request you to include some *Nepalinesses* in your theorem, when you come 'down' here, preferably in Nepal. Perhaps, you will use the model of undulating mountains to bring a relevant context for the use of your theorem. Can your theorem help map the height of our Mount Everest? Perhaps you need to take this issue into account as well. Similarly, I would like you to suggest to the teachers who have been teaching your theorem as an irreplaceable fact that your theorem is just a product of humankind.

Best wishes

Your Known/Unknown
BalChandra

After completing a preliminary draft of the text, *A Letter to Rolle*, I sought some critical advice from Peter about the possibility of including a letter-writing genre as a

research text. I had not mentioned explicitly this genre in my proposal. However, right from the beginning of this research Peter insisted that I embrace the *emerging* metaphor of research. Perhaps, if I had embraced the view that research should follow the prescribed steps and format I would either have failed many times or stopped doing this research. After skimming the letter, he asked, "What does this letter represent?" "It portrays my experiences of the nature of mathematical knowledge that I have studied. Furthermore, it raises some fundamental questions about such mathematics and conventional pedagogy," I replied. "It seems to me that you need to suggest at least one alternative way of transforming the conventional subject structure and pedagogy for your context," Peter suggested.

Given this, you may guess that *the* letter (to Rolle) symbolizes my critical reflection upon the thorny issues of subject structure and its subsequent impact on pedagogy. As you construct your meanings from the text of the letter, you will find that I have already discussed some of the issues critically. However, I have to clarify some of my standpoints regarding the *taken-for-grantedness* of mathematical (and scientific) knowledge and its impact on the pedagogy of mathematics. Furthermore, I need to speak about my standpoints on cultural relevance of the mathematics that I studied. However, you need not regard the 'letter section' as description and this (commentary) section as an interpretation, instead, both sections are my interpretations of my experiences. The difference is in using multiple genres and frames of representation.

My experiential realities depict the subject of calculus as a trail of theorems, corollaries, formulas, definitions and even some difficult but *need-to-be-remembered* problems. In my experience, the general structure of a calculus topic, which I studied, was a sequence of *definition-theorems-corollaries-problems*. What could be the basis of a definition? The answer would be a previous definition(s). Interestingly, one can arrive at the first page if he/she starts to study from the last page of the calculus textbook. Knowingly or unknowingly, this definition-based pedagogy (sternly) influenced my own pedagogical practice for some years. In my experience, the prescriptive subject culture and pedagogical practice can only produce a group of 'knowledge containers', but does not guarantee their transformation into critical,

creative, reflective and lifelong learners. In order to improve this situation, we may need to rethink our taken-for-granted beliefs about the conventional structure of mathematics. Does it mean that we should challenge the mathematical knowledge and mathematics academia? Of course, it is a challenge to the stereotypical viewpoint which regards mathematics as a *context and culture free subject*. You may agree with me that contextualisation of subject matter can help improve our pedagogical practice. For this, starting a calculus lesson at least with a contextual (viable) problem can help construct definitions, theorems and corollaries. However, it is not my rational argument that subject structure *does* influence pedagogical practice; instead, it is my experiential reality. In retrospect, a problem-based approach to education may help develop an awareness of different worldviews embedded in the learning contexts and in the subject matter.

You can raise a question: Are you rejecting mathematical theorems and definitions? The answer is not completely 'yes' or 'no'. You may agree with me that in order to construct culturally relevant mathematics, we need to examine the applied part of our mathematical knowledge. I also suspect the relevance of the philosophical standpoint upon which my *calculus* subject was built. What type of philosophical standpoint was embedded in the structure of my *calculus course*? Does it not promote an unjustifiable hierarchy of the developed and developing world, civilised and uncivilised people, knowledge and *pseudo-knowledge*, knowledge distributor and receiver, and so forth? With these questions, I encourage you to think about the nature of knowing from your experience: Is our experiential reality independent of our context and us? Was my interpretation of Roll's theorem similar to yours? Are my schemes of the concept of function necessarily exactly the same as yours? Since we cannot produce an absolute proof of the truthfulness of Roll's theorem, except for assuming the truthfulness of certain entities involved in the theorem statement (e.g., *function, first derivative of a function, existence axiom for a mathematical plane such as Cartesian plane*), the traditional notion of *truth-maps-such-reality-that-is-independent-to-the-knower* can hardly help address the fundamental problem of pedagogy—liberating learners' to subscribe to multiple perspectives. In my experience, our mathematics needs to adopt a reform-oriented epistemology of

knowing-is-dependent-on-the-knower in order to help resolve the prevailing problems and paradoxes in our pedagogical practices.

I may need to discuss the notion of *authorship* in the context of reform-oriented pedagogy. From my experience, the traditional notion of authorship did not allow us to construct and adapt the knowledge locally: we had to (re)produce Roll's theorem as though we were a dummy Roll. Specifically, embracing traditional authorship advocates the viewpoint that the source of knowledge is the author. This notion implies again that students can only receive knowledge from an authority. In my experience, this viewpoint places an emphasis on an asymmetrical power relationship between the knower and the knowledge. Consequently, in the context of the classroom, the situation is translated into asymmetrical power relationships between a teacher and students. The traditional notion of authorship emphasizes on a single worldview which does not allow to blossom different colours of roses in a single rose tree. In essence, my dissatisfaction over *the* calculus and its embedded pedagogy was: to embrace someone's single worldview without giving any opportunities to be aware of our own. Once again, you may raise a couple of question: Are you anarchic? How can the notion of authorship be changed? Let me take an example of this project report. It will be my text, knowledge and experiences until I construct meaning from it. However, your construction of meaning from my text cannot be mine.

Revisiting Peter's suggestions for constructing viable alternatives for improving the mathematics teaching-learning situation in my context, I can see some possibilities of preparing critically aware teachers who can act as change agents by subscribing to multiple worldviews. For this, we may need to regard mathematics as a human enterprise rather than an unchangeable body of knowledge. *Inclusivity*, social justice and culture-embeddedness may be some essential characteristics of my mathematics that can transform myself.

Fragmented methods and integrated contexts

'Long or Short Lesson plans?'

Place: Valley Teashop (adjoined to Nepal Universal Campus)
Time: 7: 00- 8: 00 am.
Date: Any weekdays of June 1995.
Participants: Prakash, Shyam, Sita, Hari, Rima and Sahuji.

(The tranquil morning gradually becomes hot. Three students come across from the main gate of Nepal Universal Campus and enter the Valley Teashop. (The) Sahu-ji[30] seems very happy as if they are his first customers of the day. After a minute, two other students appear in front of the shop.)

Sahu-ji: Hello Shyam *sir* and Rima *miss*! Are you looking for Prakash and your other friends? They are here.
(Shyam and Rima also join their colleagues and start to share their problems of *practice teaching* with each other. Sahu-ji asks his customers for their preferences—tea, milk, and sugar—for their morning tea. Shyam and his fiends seem very busy—Prakash is writing something for Sita; Shyam, Hari and Rama are comparing their lesson plans and their internal's[31] feedback.)

Prakash: Guys, I had a long discussion with my internal, yesterday. I commented that I could not implement his suggestion. I could not continue being a mute receptor of his impractical suggestions.

Sita: (Raising her left hand) I have also the same problem. My internal does not try to understand my situation. You will laugh if I tell you his comments about my classroom activities. I have not received any positive feedback until now. It is quite depressing…

Rima: My internal is quite different from yours. He neither visits my classroom nor suggests anything else. He says, "everything is good, fine etc." How can he say that without observing my classes?

Shyam: My internal is personally fine. He is a very good lecturer for our university courses but he does not have any experience of teaching at secondary level. Perhaps, that is why he hesitates to comment about my teaching.

[30] In Kathmandu, generally a 'shop owner' is called *Sahu* and *ji* is a connotation to respect the person. Often Sahu-ji is used as a common name.
[31] Internal supervisor appointed by Campus Administration.

(Sahu-ji brings five teacups and puts them on the table. All of them order some muffins.)

Hari: (holding a cup of tea by the left hand) My problem is much different from yours. My former and present internal's ideas are extremely different. The former internal used to prefer a short written lesson plan and focus on meaningful teaching-learning activities. However, the present internal always asks for longer and longer lesson plans. It seems to me that he ignores the context of my classroom.

Rima: Strange. Who changed your internal?

Hari: I don't know. Perhaps, he (the former one) withdrew his name or took holidays. Who knows?

Prakash: Yes, I have also found that they (internals) have quite contrary views on format, length and content of our lesson plans. It would be better for the 'practice teaching committee' to set clear criteria for judging the quality of lesson plans, teaching materials and teaching-learning activities. I do not think that only lesson plans can judge the quality of our teaching.

Sita: Do you think these lesson plans are useful in our actual classrooms? No, I don't think so. Last Friday, when I was teaching a topic called 'unitary method' of grade nine, one of the students posed an *outside-the-book-problem* related to time and work. I solved the problem by discussing with the students. I had to do that you know…? If I did not solve that problem the students would generalise that *miss* did not know anything outside the textbook. However, because of that 'problem', I could not complete one of the intended activities. You know my internal wrote one-page of comments that I was not teaching according to the plan.

Shyam: It happens in our regular class. Students may ask several questions about problems, proofs and formulas. We need to address their problems. That is why we are there. However, our internals seem to think that we are there for their (internals) purposes. In my actual teaching context (He is a permanent teacher of Deurali Secondary School, Kathmandu), these lesson plans are less useful than my own daily notes. For me, these (plans) are just a way of passing our *student teaching* course. After that,

these lesson-plan notebooks probably will go in the trashcan. It is very simple that, confined within our framed plan, we are not supposed to entertain students' questions and problems. What does this mean? We are promoting a teacher-centred chalk-and-talk approach. In my experience, most of the internals do not have any idea about school classrooms. And they don't seem to intend to learn about them, instead, they always try to implant their theories in us.

Rima: I have also some similar experiences. In my school (she is a recently employed teacher in King Birendra Secondary School), these plans are not feasible. I have to teach at least five-teaching hours per day in different classes. I can't write fifteen pages each day. It seems to me a crazy idea. It's just not practical, feasible or applicable. In my opinion, encouraging student teachers to write longer lesson plans does not help develop teaching skills.

Sita: You may wonder if I tell you about my *internal's* feedback on my teaching of a theorem about the circle. He suggested that I prepare teaching material by drawing the picture related to the theorem on a big cardboard sheet. I told him that I would draw the picture on the chalkboard. However, he insisted that I draw on cardboard and demonstrate it on a *flannel board*. I argued that it would not be feasible to make such a picture visible for fifty-five students. In response, he told me that without any such teaching material, my external evaluation would not help me get a good mark.

Prakash: Last week, my *internal* asked me to use cardboard-drawn teaching materials for the topic of algebraic expressions such as $(a \pm b)^2$ and $(a^2 - b^2)$. I told him that I used a set of small flashcards depicting the model of those expressions. I did that because if I drew on cardboard it would not be observable to all students. However, he continuously insisted that I use a cardboard drawing…

Hari: My previous internal was quite practical. He appreciated my approach of making semi-open lesson plans. However, the present internal does not regard those plans as lesson plans. In the case of teaching materials, he also insists that I always draw something on paper and display it in front of sixty students. He suggests that I do not use a didactic approach. You know, he asks me to follow an investigative activity which was explained in our method course.

Shaym: What did you say then?

Hari: I told him that it was very difficult to conduct those types of activity in that large classroom. Even the activity presented in our method course is not related to the secondary school curriculum. Have you remembered the example—1+2+3+…= n (n+1)/2—for an inductive method? There are no other examples in our *method*[32] textbook. My internal does not suggest ways of conducting student-centred activities for such a large classroom. He always recites the method's name—*lecture, discussion, question-answer, discovery, inductive, deductive* and so forth. My teaching style uses all types of method in my class. In the beginning, I introduce my lesson to the students. I ask a couple of questions. Sometimes they discuss with me. However, I experience that it would be very difficult to conduct a discussion activity in such a large class. It is not my fault…

Rima: I think our method course is not helpful for us to develop basic skills of teaching. For me, the methods prescribed by our course are not useful in our schools. Some of the teaching materials (e.g., counters, place-value blocks, flannel board) included in our course are only useful for primary level. Can you remember that I had a big argument with Dr. Tenet in our *method class*? He told us that we need to follow them in order to pass the exam. He did not say anything about the lack of explicit examples of secondary school content in our *method textbooks*.

Prakash: Yes, I remember that. What a crazy idea! Most of our internals hold the same view as Dr. Tenet. They never think out of their frame and hardly update their ideas. They use the same notes which they prepared during their student lives. Some of them translate the name of 'teaching methods' from foreign authors' books and use such methods as canons of teaching mathematics. Most of the methods we have learnt in method class have been designed for small-group activities such as guided discovery method, discussion method, and project method. All the examples are taken from foreign contexts. Most of the resource materials suggested in the methods course are either unavailable or impracticable. They (Dr. Tenet and others) always repeat the same thing year after year…

Hari: I agree with you. For me, we need lesson plans. We have to be prepared for a topic. However, it does not mean that we cannot go outside the planned activities. We need to be open… The *internals*

[32] A subject —methods of teaching mathematics—for my B. Ed course.

should try to understand our teaching from the students' point of view…

Prakash: (interrupting). Let us meet tomorrow at the same time then we will discuss other issues to promote our Sahu-ji's teashop (Sahu-ji smiles). I have solved your 'problem' (turning to Rima). I will bring that tomorrow. It is very tricky though. Oh, time is running out. I need to be in school in one hour. See you later.

(Gradually all of them leave the teashop. Prakash makes his way to school. Rima, Shyam, Hari and Sita enter the campus in order to await their internal supervisor.)

Switching off the light and the television, I am trying to create the right mood for starting my commentary for the dialogue, *Long or Short Lesson Plans*, which has been constructed from my experience as a prospective mathematics teacher. However, I am yet to be clear about the substance and the means of portraying my reflections on the context of the enacted text. Perhaps, it is a way of writing within a strict or loose edifice; it is a representational issue of being reductive or emergent by means of texts; and it is a reporting issue of being more inclusive or exclusive in terms of self-representation. Until now, my experience of inquiry as writing has focused on more emergent self-reflective and multiple experiential voices. In doing this, I am learning that I need to be more open and reflective as more themes may be embedded within my experiential texts.

Being in the context of the dialogue, I can remember many faces that I interacted with during my 'practice teaching'— a partial requirement of my bachelor's degree. We had some informal groups of like-minded colleagues. A sense of camaraderie was there: We used to help solve each other's mathematical problems; we used to share our viewpoints on political, ideological issues; and we used to share our personal problems with each other. Perhaps, such informally shared knowledge was far better than Dr. Tenet's prescriptive method of teaching mathematics. Although I have some experience of the [formal/informal] professional context of sharing ideas of teaching, the context and ways of sharing our ideas in my college's informal groups was more natural, context-rich and genuine in order to develop our own (inter)personal practical knowledge. "How would you teach the concept of circle?

What did you teach in the topic of unitary method? Could you help me with solving this problem? Could you come into my class and help control the backbenchers?" These were the means of extending our (self) *space* for others.

The dialogic context was outside the frame of my classroom learning. The formal monological context of learning created a number of dilemmas of teaching mathematics. Specifically, most dilemmas associated with my *practice teaching* can be related to broader issues of teaching and learning mathematics at secondary school level. I am not categorising them nor am I prescribing appropriate teaching methods for all Nepali schools. However, if you can understand my dilemmas then they may help you to reflect upon your own dilemmas and paradoxes of teaching mathematics. Connecting my memories with the 'method class' gives a list of methods—*lecture, investigation, discovery, inductive, deductive, project, discussion, heuristic, analytic* and *synthetic*—which I had received from my method course and its tutor. Ironically, Dr. Tenet, who used to advocate student-centred methods, never conducted any student-centred activities for our groups of fifteen prospective teachers. His powerful *student-centred method of teaching mathematics* was a trail of lectures. We received plenty of names of methods, their advantages and disadvantages, without any clear references to their usefulness in Nepali schools. Is a *classroom* really partitioned into different sectors of methods? Is it sufficient to represent a classroom by a bunch of so-called methods? How could the method course be taught effectively? Why did we not include many Nepali *good* teachers' experiences in order to improve our mathematics teaching? Were there not any cases of good mathematics teaching at local and national levels?

Rituals and traditions have their own value in our cultural contexts (Samuel & Thompson, 1990). Although the term 'ritual' deals with a single way of doing things, we have multiple ways of performing rituals: it differs from place to place, community to community. I am bringing the analogy of rituals into the context of my teaching practice. In my experience, I was prepared to promote a single ritual—for me, the rituals were developed by (foreign) experts who had hardly any experience of Nepali mathematics classrooms. Consequently, after going outside the college gate, I needed to perform different rituals. In retrospect, the classroom dynamics,

which I used to teach, were completely different from the method course's portrayal of a mathematics classroom. I had to perform very different activities from the prescriptions of my method course; I had to incorporate many 'objectives' which could not be measurable; and I had to deal with 'uneven classrooms' unlike my method course's depiction of the subtle, linear and even nature of our teaching milieus.

I have confronted some controversial issues about lesson plans, teaching materials and the feedback giving process. Specifically, the issue of lesson plans was most controversial, as I could not see any relevance in focusing only on the structured and detailed lesson plans in order to improve my pedagogy. Principally, I am not opposing daily lesson plans; instead, my concern is about the viability of that 5-topic model—*behavioural objectives, materials, activities, assessment/evaluation, homework*—of lesson plans for our teaching contexts, where our teachers had to teach about five periods per day. For me, *what we can plan* and *what we cannot* are vital for planning our daily lessons. We encountered several times *why-did-you–not-mention-in-your-lesson-plan-that-a-student-would-ask-two-questions-about-chord-of-the-circle* type of feedback-oriented questions from our internal supervisors. Specifically, sometimes we used to receive feedback like "Do not forget to evaluate students by the end of your lesson. You cannot evaluate students in the middle of your class. That was just an activity. You need to evaluate separately". Reflecting upon this situation, I would like to raise some questions: Does the five-topic format promote student-centred teaching? Can teaching-learning activities only be explained by a few behavioural terms? Is not teaching a complex human activity? Does not conceptualising teaching require different metaphors such as *teaching as craftsmanship, art* and *labour*?

The issue of teaching materials is another subject of my reflection. In my method course, there was a list of about two-dozen teaching materials. Most of them were related to primary and lower secondary mathematics, such as, triangle model from bamboos, place-value chart, number cards, and base-ten blocks. I can remember that a model of a graph-board could have a direct relationship with secondary mathematics curriculum. However, it was very unlikely to find such material in the

classroom where I did my practice teaching. The prevailing idea generated by internal supervisors about teaching materials was to draw pictures or to write formulas on cardboard paper. Often, my cardboard drawing of the midpoint theorem[33] could not be seen by the backbenchers in the large hall-like classroom. One of the problems was that the area for displaying my drawing on a flannel board would be a maximum of 1m × 1.5 m. Despite these problems, we had to draw or write something to make concepts tangible, no matter how students perceived our ways of teaching. Could a circle be more tangible by drawing on cardboard rather than drawing on the chalkboard? Do materials act themselves as improving factors for developing understanding of mathematics? What types of material do we need to use?

From my experience, we need to understand and use our local teachers' knowledge in order to improve teaching mathematics in Nepali schools. Imported (expert) views may be counterproductive as we always confuse the length and breadth of our daily lesson plans without a clear understanding of Nepali classroom dynamics. For me, taking teachers' experience into account can help promote interactions between expert and practitioners' views of teaching. In the case of *method course*, I would have learned and developed many valuable skills for teaching mathematics if I had been assigned to read mathematics classrooms rather than to memorize the advantages and disadvantages of different teaching methods; and I would have better understood the nature of teaching mathematics if I had been provided opportunities to interact with experienced schoolteachers about their (positive and negative) experience of teaching mathematics.

[33] A theorem in geometry related to the areas of triangle and trapezoid constructed by the process of connecting two midpoints of two sides of an isosceles triangle.

CHAPTER THREE

TEACHING (OTHERS') MATHEMATICS: AN EXPERIENCE OF TIME, TEXT AND TEACHING

Redefining my role in others' mathematics

'Self and Other'

He does not understand me
This means:
He does not know who I am
He does not identify what my values are
He is rather interested in him
Only in him

avoiding raised hands
suppressing many voices
living with many prejudices
making myths of developed and developing
    civilised and barbaric
    powerful and powerless
    known and unknown
    many more dual classifications
He makes him a universal,
However, he is just a dot,
    just a micro-point in the universe
    simply his way of explaining the world
The web of his knowledge
The pile of his-meaningless-to-me facts
The obscenity of disconnected ideas
Moves around my life
Trying to change me
Otherwise, at least, to *clerkize* me
Because a clerk accepts everything unquestioningly

Selfish he
does not care about me
does not want to flourish my way of being
does not intend to recognize me

does not try to be an altruist
He tries to invade me to (mis)represent myself
Indeed, he has enclosed me
As though a lid blocks the *coming-and-going* of air
As though a curtain blocks the visibility of the theatre
As though the cloud blocks the eternity of the sky

This poem entitled *Self and Other* depicts my experiential reflection of teaching mathematics in a private boarding school in Kathmandu in the mid-1990s. Perhaps, I need to weave a context-rich text in order to make meanings of the poem. With this view, I will muse over some events and contexts that led me to write the poem in order to represent and reflect upon the use of *Anglo Indian textbooks* in the school. In this storied commentary, I will discuss how I changed my perception of *Foreign-textbooks-are-better-than-any-Nepali-textbook* to *they-are-as-bad-as-colonising-our-world*.

The first blow to my belief—*foreign textbooks are better than any Nepali textbook*—was to experience the grade-two students' prevailing difficulty in solving addition and subtraction related word problems. While checking the exercise notebook of a second grade boy, I found that he was just copying the problems rather than solving them. Only three/four problems out of twenty were solved. "Why haven't you solved these problems?", I asked showing the blank pages of his notebook. He stood up with an uneasy smile. I told him to sit down, and asked other students to open their exercise notebooks. Most of the students' status was not different: No one had completely solved more than four problems.

This was, probably, my first direct experience of witnessing the negative outcome of my own teaching. I remembered that one of my colleagues had blamed grade four students for not being able to understand his teaching. He showed me the students' homework and complained, "These students are completely hopeless. They are all rubbish. They have no brains." I could not say anything except to smile in order to demonstrate my neutral position on this issue.

I started to reflect upon the students' difficulty in developing problem-solving skills. I shared this problem with my colleagues. There was a single suggestion: Encourage students to memorize typical (what about atypical?) problems and problem-solving styles. This opinion represented a majority of my colleagues' perceptions about mathematics and mathematics teaching. However, I thought that my teaching style—mass lecturing—could be an inhibitory factor for not helping them to understand the mathematical problems. Next time, I tried to use the strategy of *teaching-as-a-series-of-dialogues*. I wrote six problems on the chalkboard in order to make them busy during my consultation with each student. Talking with each student within a small group or individually gave me a different experience from 'teaching from a distance'. Although, I could not figure out any specific reason for not being able to understand the problem-solving strategy, this teaching approach gave me an opportunity to understand a different landscape of teaching. I adapted an individualised and *small group discussion* approach to instruction in grade three, four and five too. Despite the change in teaching style, the enigma was still unresolved—the majority of students were not comfortable solving many bookish problems.

One morning, a grade four student told me that she could not understand the meaning of two words mentioned in a problem. The words seemed to me to be the name of a south Indian person – an Indo-English name. I told her simply that it is a name of a person just like her. She then asked, "Why is there no Nepali name like ours?" The student, who was sitting next to her bench, turned to the second page of the book and showed me the name of the place where the book was published. He said, "Don't you know? This book is prepared in New Delhi."

The question—*why-is-there-no-Nepali-name*—echoed in me frequently even after entering the fifth grade room. There, my plan was to discuss some methods of drawing bar graphs. I turned to the page on which the example of a bar graph was presented. The names mentioned on the horizontal axis sounded like some Indian cities. The problems of the exercise section were to draw bar graphs representing the monthly temperatures of Nasik, Madras and so forth. At that time, I asked myself: Do I need to use these examples instead of using our own cities' temperatures? Do I continue to teach about Indian names, places, states in the name of teaching

mathematical concepts and problems? Next day, one of the fifth grade students asked me whether it would be correct to write *paise*[34] in order to denote the smallest denomination of Nepali currency. I told him that the correct spelling is '*paisa'*[35]. Then, he turned his mathematics book's page and showed me the word '*paise'*. It was another strong evidence for me to be critical about the utility of such textbooks. You can argue that 'context' does not matter for developing conceptual understanding. However, for me, this is one of the main reasons for students' inability to make correct sense of the problems, concepts and whatsoever. You may agree with me that the process of understanding a concept does not only involve intellectual activity but also embeds cultural capital, emotions and personal perspectives of the learner within it.

I, then, started to be self-critical of my earlier standpoints on the quality of a mathematics textbook. However, I cannot say that I was perfectly critical of my own taken-for-granted beliefs. Instead, I was suspicious about the textbooks, so-called English medium classrooms, my role as a teacher and the *would-be* culture promoted by the (private) school. As I started to express my dissatisfaction about the mathematics textbooks, one of my colleagues expressed a similar concern about the science textbook. He told me, "I found that these (science) textbooks are not relevant for us. For me, the *government textbooks*[36] are a little better than those foreign textbooks because they have been written by a group rather than a person. Why don't we translate them into English, if English is the main indicator of quality education?"

The school, where I was teaching, had determined its motto as 'quality education for transforming all students'[37]. Directly or indirectly, the notion of quality education was to prepare students for *'Others' World'*. Perhaps, the prevailing (mis)conception about quality education was to teach from the foreign textbook in a highly prescriptive and monological manner. In retrospect, I will raise some questions here: Is learning mathematics purely an intellectual activity? What types of role do

[34] The smallest denomination of Indian currency.
[35] The smallest denomination of Nepali currency.
[36] Generally the textbooks prepared by Curriculum Development Centre (CDC) are called *government textbooks.*
[37] Pseudo-motto.

students' cultures play in mathematics learning? How can beliefs be accommodated within mathematical thinking?

A short story: Mr. Trade, Dr. Prescription and my students

It could be any morning of the last week of July 1994. I told the school principal that the textbooks were not relevant to our context. I pointed out examples of how the textbooks had made mathematics a more difficult subject than it is. She neither supported nor opposed my standpoint about the mathematics embedded in the textbook series. She suggested that I discuss this issue with Mr. Trade (a school board member), and she confirmed that Mr. Trade would be available in the school next day.

I met Mr. Trade in our staff room at 10:30. After returning his normal but non-egalitarian greeting, I started to present my problem. "I have been facing some language-related problems associated with these textbooks," I pointed to the pile of books and continued, "The names of persons, places and even examples are not familiar to our students, therefore, it is very difficult for them to understand mathematical concepts, and to develop problem solving skills."
"Sorry, I don't understand your point," he said.
"For me, the textbooks are not relevant to our context. So, we need to find another set of textbooks for the next academic year," I clarified, "I am planning to revise some chapters for the remaining classes of this academic session."
"What are you saying? How can you challenge this 'Universal Publication'? It is the best publication in our region," he said disagreeably.
"Maybe in other subject areas. How can I say these textbooks are good while our students cannot make any sense of many problems and examples?", I opened one of the textbooks.

"These books have been recommended by Dr. Prescription. Do you know him? For me, the names of persons and places do not make any difference in mathematics. Instead, the major issue is conceptual understanding. Mathematics is universal. It is

everywhere the same. You know this!" He tried to depict Dr. Prescription as a messiah of Mr. Trade's mathematics.

This discussion ended with the board member's one-sided decision that the textbooks would not be changed unless Dr. Prescription recommended it, and I could not make any changes because that would degrade the standard of mathematics of his school.

I became so sad for not being able to make any changes. For a moment, I felt that everything was against me – the school building, the garden and the electricity poles. I had to be quiet for a while in order to cool off. So, I went to the eastern corner of the semi-grassland and mulled over the issue I had raised with Mr. Trade. "Are there no mathematics textbooks written for the Nepali context?", I murmured to myself, "Does mathematics necessarily mean teaching foreign terms and places?"

"What happened in the meeting?", asked a colleague. I had to say that I was not able to change the situation. I had made it clear to him that our school's education was being made a private commodity in the name of 'quality education'. I admitted that we were not preparing our students to become creative thinkers: Instead, we were turning them into a mass of hopeless knowledge receivers. I mentioned explicitly that we could not act as teachers but as clerks of the 'school board'. How painful was that situation! A common phenomenon in a Nepali private boarding school!

After this conversation, Mr. Trade, myself and other teachers moved on according to own (subjective) times. For that moment, Mr. Trade was victorious. I had to accept that it was a time for my defeat. When I met Mr. Trade two months later, it seemed to me that his earlier standpoint was at risk because of some of the parents' dissatisfactions towards the textbook series. However, he did not make any explicit comments about the textbooks and our earlier discussions. By the end of that academic year, he told me that Dr. Prescription asked him to experiment with that textbook series for one more year. I was a little bit glad with his acknowledgment of moving towards a slow path of realisation that we were (viciously) experimenting with others' mathematics to our children by using their precious time.

Conceptualising 'time' of teaching foreign mathematics

'Time and curriculum'

Time as control
embedded in a so-called objective algorithm
with beginning, middle and end
Is it my beginning?
Is it others' beginning?
Is it my students' beginning?

Time as control
depicted as a symbol of limitedness
represented as a power for success
- success of a limited group
- success of privileged
- defeat of deprived/weak

is to discard an existence of others' time
- teachers' use of students' time
- parental definition of children's time
- authors' definition of time for readers

Time as experience
deals with a person's subjective *lifeworld*
enacting with person and events
moving with the time of the person
rather than standing outside his/her experience
increasingly, experiences embed multilayered time
with multiple personal dimensions
with multiple constructions

Time as experience
counters the notion of single concepts of time
gives a space for my time and other's time
helps create my and our algorithm
promotes a multitude of *mathematics*

Time as myth
- a constructual contrivance
- a culturally viable construction

an intersubjective perspective
a hidden but vital curriculum for a school
mythicises everything
it is math time
it is geometry time
it is algebra time
may restrain/facilitate a person's knowing

Poetic representations can be a means of expressing complex experiences by using metaphors, analogies, images and rhythms. My aim in writing the poem titled, *Time and Curriculum*, is also to portray my experiential perception about my time of teaching (others') mathematics. I could write a short account of my experience of time, I could interpret a vignette about time, and I could construct a story about time. However, the complexity of depiction, the intricacy of portrayal and the crisis of selection of texts led me to write this poem.

Interpreting a poem is a challenging task. However, it is not impossible. Perhaps having multiple possibilities of interpretation can lead towards a crisis of selecting an appropriate genre (for whom?) of interpretation. For instance, someone can interpret a poem by writing another poem while others can illustrate its meaning by using their lifeworld experiences. Although the appetite of searching for a legitimate representation is forever incomplete, I have to make a choice to make sense of the poem in my experiential reality. Here, I choose the second option for illustrating my poem.

Initially, I faced a big dilemma of prioritising my job or my own studies when I started teaching in February 1994. I was dividing my (study) time as though I was justifying having plenty of time for my studies. The division of time was my constructual phenomenon: Mornings and evenings were for studies and daytimes were for the job. In the school, a matrix drawn on an A8 size sheet of paper started to represent my time. In the classrooms, some of the kids used to focus on their watch from the beginning of my teaching (Perhaps because of boring math time!): A back and forth situation was there—looking at the chalkboard and at their own watch.

Colonising others' time was a regular phenomenon in my teaching. The set of foreign textbooks, which I used as prescribed textbooks, used to colonise my time. In succession, I had also colonised my students' time. Once, teaching the topic of simplification of algebraic expressions in grade five, the electric bell did not ring for a while. I used that moment to finish that chapter. I did not look at my watch nor did I hear the 120-decibel *'kring' 'kring'* of the bell. I did not notice that other students were enjoying their lunch break. Someone knocked on the door. "Perhaps, our attendant is distributing a notice from the principal," I guessed and opened the door. "What are you doing sir? We have finished our lunch. It is time for lunch break," was a colleague. Then, I looked at the place where the electric bell was kept. It had disappeared. Indeed, I had used their valuable time for teaching foreign mathematics.

My poem is intended to dispense a sense that time is different from person-to-person. In the school, the notion of time was taught, learnt and used differently from one subject to another. When I was passing by the passage outside the main lobby, the Nepali Language teacher was explaining the importance of time as though he could bring a (non-solid) model of time into the class. I stopped for a while and listened to his divine-like lecture delivered to a group of eleven-year old children:

> …Time plays a very important role in our life. You need to understand that we cannot see time in a solid form. It moves from past to present and then to the (?) future. It is non-repeatable. It is moving ahead. So, you need to be like time—powerful and forward looking. One of our poets has suggested that we do not disregard the role of time but keep on moving according to its pace. If we do things in time, we can correct them later. Otherwise, we will have to face consequences. For instance, if you did not complete your homework by this evening, then you would not have time for looking back on it.

After listening to his lecture, I moved towards the fourth grade room in order to prove my on-time presence in the class. As I entered the classroom, one of the students told me that he was not able to solve a problem related to the division algorithm of time. "How can a moment be divided?", I murmured to myself. However, I was not in the position of asking questions about the meaning of 'dividing' a moment: Rather I had to make (or pretend to make) meaning of that divided time. Mechanically, I divided a whole moment (3 hours, 58 minutes and 45

seconds) into three fold as though a page of paper was divided into three one-third folds. What does that mean to the little kids? What do they mean by dividing time, as they conceptualise a single dimension of time?

One morning, I was not in a good mood because the school principal told me that I was not strict enough about the timing of students' arrival. Whilst I started to call the *roll number*, three students appeared at the school-gate approaching my/their class where I was desperately waiting for them. "May I come in sir", was the chorus. "No, you cannot. You are late. You have to state some good reasons", I said quickly. The first latecomer told me that she had taken a long time to finish mathematics homework. The second gave the same reason. The third could not produce any reason immediately; immediacy and urgency were her need as her two time-neglecter friends were already inside. " Sir, I am so sorry that I slept until seven o'clock. I had to finish my homework. It took a long time to understand the 'problems'. I had to use my mum's time. Poor me!" It was her good reason. I let her in by saying " Next time you need to produce a better reason than this."

Some people wish to cease the movement of time at least for a moment. Perhaps, they try to create another myth of their time. I wished I could play my divided role at the same place and time. Even within the school, I was divided into different blocks of time. My and my students' wholeness could sometimes be a matter of suspicion. "Where have you been Anita?", I asked a first grade girl who came to the class ten minutes later. She smilingly replied, "I was playing table tennis, sir." "Is it a time of playing or paying attention to your mathematics?", was my question. "Surya *sir* took us to play", she said confidently. In a moment, Surya appeared at the window and whispered, "I did not notice that it is your time. Perhaps, we need to change our routine." Thanks to the time which made him rethink his own carelessness about others' time. I told him, "You have to pay a price for (mis)using others' time. You must know that time is non-repeatable and non-usable. I cannot use the time which you have already used in my name. You must know this is math time". I had used the myth of *objective time*.

In the beginning of that job, my aim was to improve my English. Nevertheless, it was a big challenge to create an English-speaking environment in each of the 45-minute teaching hours. The moment used to be too long *as though* I was staying for a whole day in a dark jungle. One of my colleagues, who was sitting behind my class, told me that I was using very difficult words for the kids. However, he had metonymically represented my whole class by his ten minutes of idle observation (I observed his observation that he wrote two words on his palm!). Next day, it was my time to be in his class. It was very hard for me to distinguish between a university lecture on photosynthesis and his explanation about the importance of sunlight for trees. After his class, we sat at two adjoining benches in the school's self-proclaimed cafeteria in order to utilize our revenge time: We did not speak for a while. He suddenly admitted that it was very difficult for him to simplify all of the *scientific processes* in simple English words. I admitted the same.

I was accustomed to act according to the time of the school. Indeed, I used to be very busy all the time *as though* I was running out of my time. I insisted to all my students to act according to my time: Their time used to disappear. One weekday of March 1994, an eight-year-old boy's father requested me to advise (which could lead to a physical punishment) his son because he did not utilise his (father's or son's?) time to study mathematics at home. After I advised him to pay more attention to his studies at home, the boy started to keep away from me. He could not appear in front of me even though I met him outside the school (in a cinema hall). His time and my time became parallel: According to the boy's father, this was a quality of a good teacher. One month later, the boy's father appeared in the school. He told me that he was very happy with a major improvement in his son's mathematics score in the monthly test. His continuous feedback about my teaching made me curious to know more about him. When I asked about his job, he replied, "I work in the Ministry of Education. Sorry sir, I will talk to you later because I have to participate in a donor-sponsored meeting on school curriculum." My mind started to think about the (cruel) time which made many of us live a series of contradictions.

> O time,
> run yourself
> wander yourself
> don't try to capture my moment

don’t tell me to capture other’s time
move according to the need of others
but not according to your need.

CHAPTER FOUR

ENCULTURATION, POWER AND MATHEMATICS

Enculturation, pedagogical tactfulness and reform

'Generating moments'

It could be any day in December 1995. We had been waiting for Dr. Acharya, who was the tutor of our statistics course, for fifteen minutes. Time was passing so rapidly that we could barely complete a 'problem'. "Is he coming?", I asked a student who was coming from the staff room. "I saw him there," he continued, "discussing with other teachers. Perhaps we need to present ourselves in front of him to remind him about this class. He needs to learn about the qualities of a good teacher " I just smiled. By then, Dr. Acharya appeared on the way to our classroom. He raised his right hand as his way of greeting. His initial greeting to his students could be a symbolic apology for being late.

"How are you folks? … My colleagues started an issue. How could I help myself without contributing my ideas?", Dr. Acharya said in a giggling voice. " "Let's open this chamber. Oh, it is still closed."
He opened the door of the 'math lab'. We entered the rather dusty room full of unused models, pictures and posters of different mathematical concepts. Opening two wooden windows was meaningless as the outside light was becoming dim. One of the students switched on the only light available for the congested room.

Dr. Acharya put his bag on a table, and then sat on a chair near the blackboard. He took off his spectacles and cleaned his eyebrows and other parts of his tired face with his handkerchief.
"I have been here (in the college) since this morning," he opened his bag and took some computer-printed pages out. However, his handouts seemed to be an assemblage language of more than one author. Worst of all, his typos made me turn several pages of dictionaries for nothing. "Where are we today?, he showed his big eyes to us. "We finished the topic of frequency distribution and density function. Perhaps we need to discuss about their properties," said Rajesh. " These properties may not be so important for your exam. We need to move on to moment-generating function", he proposed. We had no alternative but to agree

with him. Then, he slowly stood up with a couple of A4 pages in his left hand and a piece of chalk in his right hand. He tried to find a duster to clean the blackboard but could not. Confused, he cleaned it with his own hand. The left arm of his black jacket was full of creamy-white dust.

He started to write the definition of moment-generating function[38]. The word 'moment' was quite familiar to me. However, the canon of definition captured the common idea into a conduit of words and sentences. He dictated the definition from his page as though he was performing an identical transformation of the letters, words and sentences. He continued his writing without speaking any words. Sometimes, the tattered blackboard used to block his writing. However, he did not stop until the board was full of his rather curly English. The classroom was pin-drop silent. All of us were busy creating others' texts in our personal notebooks. It would be an exception if we correctly copied all the words from the blackboard.

"Have you finished?", asked Dr. Acharya by sitting on the chair, " I insist you complete the later part of the derivation."
"Could you please explain up to the last step, sir?", asked Samir. He read out all the sentences he had written on the board. That, at least, helped us to become familiar with his writing, although we expected some lively examples of moment-generating functions rather than the syntactic representation of their definitions and derivations. More than that, we expected examples which we needed to use in our immediate experiential and societal world.

"This may be more important for your exam than for your future use," Dr. Acharya continued, "This course is older than many of you. I had also studied the same subject matter in my M. Ed studies. It is no wonder to say that I am teaching in the same way I had been taught twenty years ago." We did not react, as we were accustomed to listen unquestioningly to his lectures.

[38] Moment generating function can be expressed as $\sum e^{tx} f(x)$ and $\int_{-\infty}^{+\infty} e^{tx} f(x)dx$ for continuous and discrete random variable x respectively.

We had half an hour to finish the class of that day. "How many of you are planning to prepare for the statistics exam?[39]", he asked all of us. Most of us were confused. I raised my hand and a couple of other students did the same. " Have you heard anything about last year's exam result?", he took off his glasses. Indeed, we were informed by the second year students that only one student passed the statistics exam out of two/three hundred regular students. " It is quite frustrating. The course of studies, textbooks, exam questions do not match each other," he expressed his dissatisfaction. "What may be the reason sir?", we asked collectively. " I don't know", he continued, " However, we don't have an adequate system of support and facilitation. Rather, most of the professors, who assume themselves to be messiahs of their subjects, never listen to these problems." We did not try to stop him. Instead, we were eager to listen to the problems that could impede our future as well. "It is my second year of teaching this subject at this level. I forgot many of these theorems, exercises and whatsoever, as I did not use any of this mathematical content after my masters' studies." He tried to demonstrate some casual relationship between his (poor) teaching performance and the university system. "If you check last year's statistics question, you will find that most of them are not related to educational contexts. For instance, the problem related to analysis of variance is about a treatment effect in agricultural contexts," he continued, "Within our academia, the exam is regarded as a means of producing a large number of failed students." More than that he told about his experience with one of the professors who had kept a book on mathematics and never lent it to his students or his colleagues. According to Dr. Acharya, the book was out of print. However, until the time of his retirement the professor continued to make exam questions from his secret (sacred) book. After listening to his somewhat egocentric monologues (however, they helped us to be aware of the situation), we left the lab room around quarter past eight.

The story titled, *Generating Moments*, depicting my experience as a first year masters' student, helps uncover some issues about mathematics teaching and learning at that level. Although, I often experience a crisis of demarcation between a storywriter and a commentator, I have chosen three issues—pedagogy of

[39] In the university system, students could postpone/fail their first year's exam. It could not stop them from continuing their second year's studies.

mathematics, cultural issues and personal roles for improvement—to explore my perspectives as a reader of the story.

I start this paragraph with an interesting insight of Gattuso (1994) into mathematics teachers. He ends his article, *What Happens When Robots Have Feelings?*, urging all mathematics teachers to think about why mathematics teachers are regarded as non-human robots. Quite rightly, Gattuso's worry has been connected with my storyline as the teacher character subscribes to the metaphor of teaching as 'copying and pasting' texts from books and notes. Perhaps, countering the notion of *robotism* is to reconceptualize a viable pedagogical standpoint in order to make sense of teaching mathematics. In doing so, I will focus my discussion on some possible ways of improving the situation mentioned in the story.

Perhaps, there is no single answer as to how a particular concept can be taught better. But this does not mean that we cannot improve our pedagogical practices. Examining self-situatedness and sharing our ideas with others are some of the easier ways of improving our teaching practice. Specifically, examining self-situatedness involves the notions of *reflection-on-action* and *reflection-in-action* (Schon, 1983). As a teacher, I can construct a better pedagogy for my students by examining my own practices. However, there are certain constraints which can hinder a teacher from being self-reflective. Max Van Manen suggests *pedagogical tactfulness* as an alternative approach to desire to control (cited in Brown, 1992). I can see and experience (perhaps it is a benefit of being a writer) a crisis of pedagogical tactfulness in my *teacher character* as he rarely focuses on the values or the usefulness of the subject matter for other than examination purposes. The notion of *desire to control* opens a space for discussing the notion of enculturation. Specifically, regarding mathematics as an *infallible*—a perfectly and rigorously structured body of knowledge without any trace of imperfectness in its structural rigour—and absolute body of knowledge promotes a monocultural and static perspective of learning. Indeed, we have forgotten that mathematics has always been a fallible and *nearly structured* subject (Davis & Hersh, 1981). The unquestionable nature of subject matter and uncriticality towards its ontological viability (e.g., does a particular subject/concept represent my/our realities?) are some indications of

adopting the century-old *industrial model* (e.g., focusing on quantity productions of teachers rather than on quality transformation of their pedagogical perspectives) of teacher education.

The question of appropriateness of subject matter in the context of preparing teachers and teacher educators is vital. In my experience, most of our personal pedagogies are derived from our immediate experiences of how we have been taught. From this perspective, the way we teach day-to-day in our classrooms is more indicative than what we teach (cf. transmit to) our students. However, I cannot deny the need of appropriate subject matter as we have a tradition of enacting the *myth* (Taylor, 1996) that the world is divided into different 'subject faculties'. While selecting subject matter and making them *learnable*, there may be some issues to consider. In my perspective, regarding *mathematics as content* rather than a space for social activity can never help to bring personal and cultural perspectives within the human-made rigidity of the so-called mathematical domain. Deniability of cultural and personal perspective in the domain of mathematics can render mathematics as exclusive to a particular group. Indeed, such mystification of mathematics needs to be countered in order to develop a politically inclusive, socially useful and contextually relevant mathematics. In this connection, Paul Ernest (1991), a philosopher of mathematics education has to say:

> … the public educator mathematics curriculum reflects the nature of mathematics as a social institution, with all the powerful educational implications of this perspective. The roles of different races, countries, and of women in creating mathematics are recognized, leading to the rejection of the myth of white European ownership of mathematics. Also history and human context of mathematics become of central importance, leading to a less alienating and mystifying image of mathematics, and giving rise to one that is more humanistic and welcoming. (p.211)

My story indicates a typical culture of establishing control over others by using an out-dated book (or perhaps knowledge). For me, the scenario can conceptually match with Van Manen's notion of *desire to control* in the form of technical rationality (Brown, 1992). In my experience, technical rationality prevails within the (so-called) academic culture of mathematics as a means of suppressing other('s) ideas.

Furthermore, it can be an example of how the myth of *hard control* (Taylor, 1996)—controlling others in the name of laws, definitions, theorems and other form of static knowledge(s)—prevails within academia.

'*One person can make a difference*' is a popular adage often used to demonstrate an important role of a person within an institution. In educational milieus, the saying is more important than in other contexts, as changes have to take place from a personal level. We can argue that every system can be a constraint for changing our way of acting. Constraints are everywhere. I can be a constraint to improving myself. Primarily, I need to recognize constraints in my thinking. Then, I need to transform my ideas in order to see the pedagogic world through the *window* of transformative pedagogy. Viewing one's self-role as a catalyst, a teacher (educator as well) may not only improve his/her pedagogy but also help (tactfully) to improve others' practice. Indeed, such pedagogical reform is likely to be more sustainable than an externally mandated pedagogy.

Social and cultural dimensions of mathematics

'Three Mathematical Contexts'

Context 1

It could be any day in April 1997. Mahesh, Tanka, Rajesh and myself were discussing some theorems of Real Analysis. At that time, we were in second year and about to complete our masters' studies by the end of that year. "I am quite confused with the notion of bounded sequence," Mahesh continued, "Can we give some easy-to-understand examples?" I had to answer such queries because I was supposed to be better prepared in the subject matter than the other students. I drew a straight line and put a zero on the left end and a ten on the right end. I then asked my colleagues to explore a sequence within that range. Tanka suggested that $\frac{1}{n}$ would be a bounded sequence for $n \geq 1$. Similarly Rajesh explored a simple example that a sequence like {1, 2, 3, 4, … 10} can also be labelled as bounded. "Do we need any conditions to define a bounded sequence?", asked Mahesh. "I would say: yes," I continued, "for example, 1/n will be unbounded if n tends to be zero." In this way, we explored

plenty of examples of bounded sequences. Similarly, we also collected some semi-bounded (lower or upper bounded) sequences. Now, it was time to discuss the definition of the bounded sequence. The definition was stated as 'a sequence $\langle U_n \rangle$ is bounded if and only if there is some K (a real number) such that $-K \leq U_n \leq K$ (i. e. $|U_n| \leq K$) for all n. "I am confused with the real number 'K'. How can such number be conceptualised?" I tried to explore a set of upper bounds of the sequence $\frac{1}{n}$ for $n \geq 1$. "Can a set like {1, 2, 2.5…} be a set of upper-bounds of the sequence? What about the lower bounds? How about a set like {0, -1, -1.5…}? Can it depict a set of lower bounds of that sequence?" These were our basic questions for discussion. We agreed that K could represent a set of lower and upper bounds of any bounded sequence. Furthermore, we meditated that in the case of unbounded sequences the set of upper bounds and lower bounds would be unlikely to exist.

Context 2

Next time Rajesh, Hari, Tanka, Subash, Ganesh and myself shared our ideas on convergent and divergent sequences. Hari insisted that we compare the literal and mathematical meanings of the terms 'divergent' and 'convergent', by using the Oxford Advanced Learner's Dictionary and the Penguin Dictionary of Mathematics. "Oh, it has turned out to be entirely different from my common sense understanding," said Hari. "What did you think before?", I asked. "I thought that divergent means something 'curved' and convergent means something 'straight', " he said. Rajesh added, " My prior interpretation of convergent sequence is a shrunk sequence into a very narrow range while divergent was stretched into a wide range." Interestingly, Subash's idea was more mathematical. According to his understanding, if the limiting case of general form or forms of a sequence tends to a finite number, then the sequence would be a convergent one. Otherwise, it would be a divergent sequence. In this way we shared our understandings and constructed meanings of such abstract concepts.

Our attention was drawn to *Cauchy criterion* of convergent sequences[40]. The notion of epsilon (ε) was quite problematic in order to justify that a sequence is convergent. "I think epsilon is the smallest possible real

[40] Let u_n be a sequence of real numbers. The sequence satisfies the **Cauchy criterion** if for each $\varepsilon > 0$ there is an integer $N > 0$ such that if $j, k > N$ then $|u_j - u_k| < \varepsilon$.

number under given conditions," I opined. We tried to check the idea in the case of some convergent sequences such as 1/n, n+1/n and $n(n+1)/n^2$. "Can we test this idea?", Tanka sought for an example. " Sure. For instance, for n+1/n (I solved for the relation of epsilon), we get $n>1/\varepsilon$." I tried to make sense. "We can find 'm' somewhere between 'n' and '$1/\varepsilon$'," opined Subash. Discussing some other examples, we crystallised its meaning in the context of convergent sequences and their unique limit point.

Context 3

Temporally, this parable is related to an event that occurred three year after my masters' studies. However, it has a meaningful connection with the year 1997 and Real Analysis. During the second year of my masters' studies, I had prepared some pictorial models depicting abstract mathematical ideas including the cardinality of sets. Sometime later, I was requested to present some mathematical models and posters in a seminar. One of my posters was about the cardinality of sets (Figure 3).

"Oh it is nice, looks like a temple", a gentleman continued, " Can you explain it to me?" " Sure," I started to explain, "the bottom of the picture is for the finite sets, the middle is for countable finite, and the top section is for infinite sets." "Very interesting! I like this explanation. As we move to infinity we may move to an ideal point," commented the gentleman.

"What is the basis of preparing this model?", asked another gentleman. "It is based on my understanding," I replied. "How can you say that there exists a transfinite number between the finite numbers and an infinite number?", he asked again. I exemplified three different types of sets such as the set of counting numbers up to ten, the set of natural numbers and the set of all real numbers. "This is the basis of what I understood about three different types of numbers that represent the cardinality of three genres of sets," I completed my answer. Other people seemed to be convinced by my ideas. However he was continuing to blame me for making mathematics impure by not proving rigorously to justify my model. I could say to him that there are many *believed-to-be-true* mathematical statements and theorems that are still unproved 'mathematically'. Proving everything can take us to the challenge of proving the correctness of our way of proving mathematics. Can we prove

at all how we correctly represent our ideas? Can we prove the truthness of a mathematical statement without taking the 'existence property' into account? Why do we not think about the viability of a certain model of mathematical thinking within some cultural realities? Why do not we take ontological viability into account while making a sense of complex mathematical ideas in our contexts?

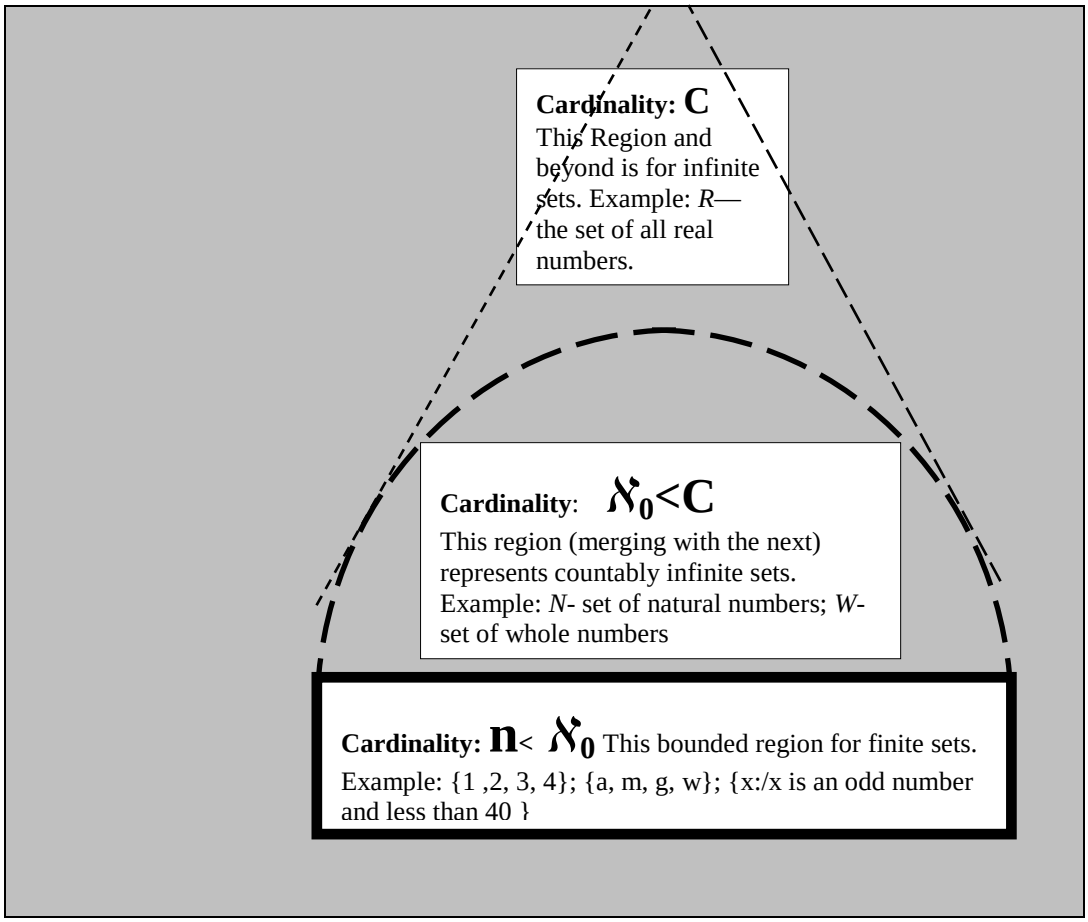


Figure 3: A model showing hierarchical relationships between cardinalities

I read my self-written vignette, *Three Mathematical Contexts*, from two perspectives. First, I read from the perspective of the social dimension of mathematical learning. In order to discuss this issue, I raise a couple of questions: How can we promote the method of connected knowing in our mathematics classrooms? Does it mean that we can regard *socially mediated (cf. constructed)* learning process as a reform-oriented pedagogy? Second, I wish to discuss some obstacles to introducing cultural and personal dimensions in the reconceptualisation of mathematics in my cultural contexts. Furthermore, I will argue from the perspective that bringing cultural and

personal dimensions into mathematics can uncover multiple possibilities of interpreting mathematical concepts in personal and cultural landscapes.

In my experience, the method of *connected knowing*, which promotes empathetic understanding by showing a willingness to suspend personal judgement(s) about others' knowing (Dawson et al., 1999), can help construct contextual meaning of abstract mathematical concepts. Another important feature of connected knowing is to find connections between the constructions of cognising subjects. Perhaps, in the traditional view of mathematics learning, the notion of *empathetic understanding* and connecting with others' constructions seems to be an unmatched perspective. In my view, these features can be best explored by subscribing to alternative epistemologies of mathematics education (e.g., ethnomathematics, social and critical constructivism). However, it does not mean that one cannot use a connected approach to knowing within the traditional paradigm of mathematics education.

Our mathematics classes, which subscribe to student-centred teaching as a means of reforming pedagogy, may have delimited the meaning of *dialogue between teacher and students*. Misleadingly, we might be regarding *student centeredness* as a way of probing teacher ideas by simply asking some yes/know questions. However, in a broader sense, we need to promote student-to-student dialogues in order to enable students to understand each other's constructions. In doing that, our *bipolar centeredness* may be transformed into a multipolar one. For me, in the multipolar context of learning, students can construct different examples, multiple ways of solving problems and multiple meanings of mathematics concepts.

That promoting connected knowing can help manifest multiple meanings of a mathematical activity is vital in the process of constructing, representing and reformulating a mathematical idea. For me, Paul Ernest's (1991) model (Figure 4), which portrays a cyclic development of mathematical knowledge through *the creation-learning dimension* and *the subjective-objective knowledge dimension*, has some relationships with how my friends and I learnt the concept of sequence, divergence and convergence of a sequence as depicted in the story, *Three Mathematical Contexts*. Specifically, dealing with mathematical concepts within the

subjective-objective/[*intersubjective*] and *personal reformation-public criticism* dimensions can help the development of multiple meanings of abstract mathematical concepts, theorems and problems. Furthermore, the interaction between personal and public perspectives can facilitate to view mathematics as socially constructed knowledge and a process of knowing. However, I prefer to say *subjective-intersubjective dimension* in order to highlight the often-neglected relationship(s) between personal and *consensual* dimensions of knowing mathematics.

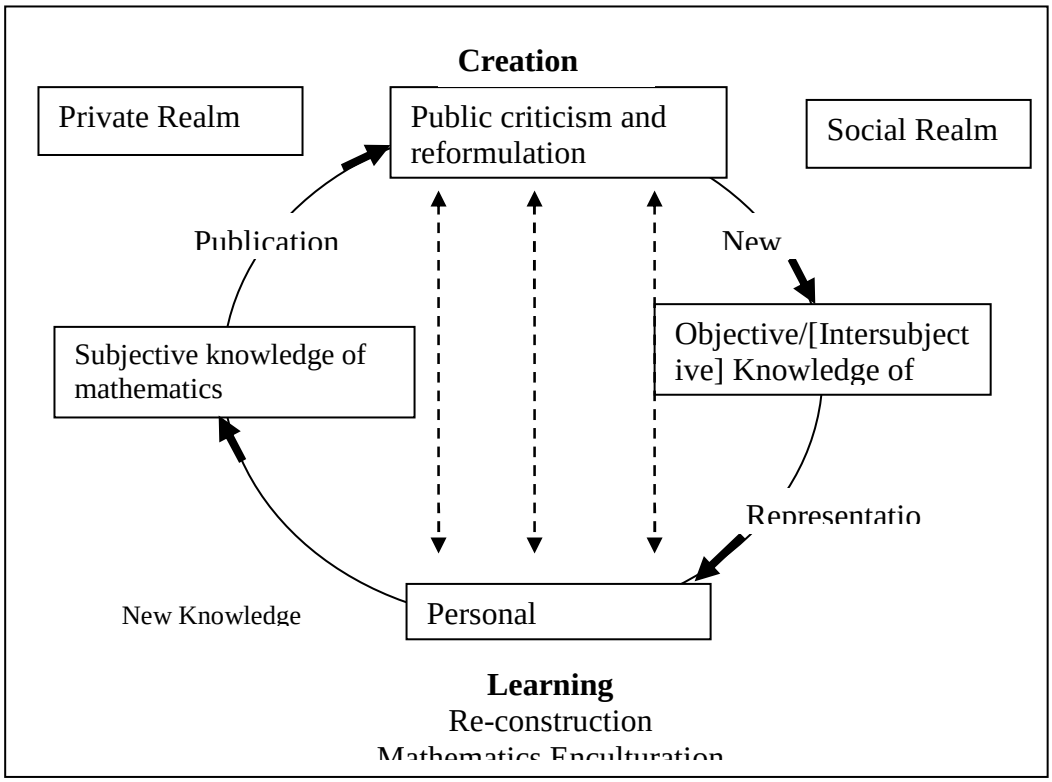


Figure 4: The relationship between subjective and objective/[intersubjective] knowledge of mathematics (Cited in Ernest, 1991, p. 85)

I have already discussed some of the aspects related to the second issue—obstacles in introducing cultural and personal dimensions in mathematics. Indeed, it is a difficult task to separate such intertwiningly complex issues. However, most of the time, we pretend that we can separate all the complexities from each other. This analogy may be applicable to my second issue, as the second gentleman (in the vignette *Context 3*) seems to believe in the notion that mathematical knowledge is a smooth canon of proofs. However, he may forget how he uses (tacitly) unproved mathematical ideas,

models, theorems and genres in his day-to-day life. Regarding *cold reason*[41] (Taylor, 1996) as the only way of generating mathematics may lead to an elite form of mathematics that has been used only for intellectual pursuit. The refusal to include personal perspectives in mathematics can be best described as a neo-colonised mentality of one-sidedness. For me, personal and cultural milieus can help enrich mathematics education in order to promote its cultural contextualisation.

The mathematical system of proofs, which have been labelled as objective (and *cookbook*) entities, has evolved from a personal to a consensual perspective. However, presenting multiple mathematical genres as objective, unquestioning and sacred knowledge may advocate teaching as a *one-way-street* pedagogy. Perhaps, the person who argued 'for producing a proof prior to make a model' could not take into account the three operational types of mathematical knowledge: syntax, semantics and pragmatics (cited in Ernest, 1991). At the semantic and pragmatic levels, we can communicate about the usefulness of mathematical knowledge in our life while the syntax level seems to be delimited to producing the *grammar of mathematical proofs*. What is more important for our schools: a grammar of proofs or pragmatic mathematical knowledge?

Searching for our history of mathematics

'The History I read'

The history of mathematics I read
    as an unalterable text
    as a personal/cultural perspective
    as a collection of facts
    as a fictional elaboration of facts
    as an ideological representation
Moving near to the text
It throws me away
It tries me to sway
    by its single worldview
    with its ideologies

[41] Rationally guided deductive (Platonic) logic—which refutes *experiential logic*—as the only way of knowing mathematical principles.

with its power
with its factual/fictional plot
Viewing with its lens
that sees others mathematics shaky
that labels others geometry unsteady
that brands others number system lengthy
that depicts others' spatial reasoning faulty
As it subscribes to 'text as meaning'
my history becomes invisible
my existence turns out to be indistinguishable
my mathematics seems to be unacceptable
my construction of meaning becomes meaningless
Upon arriving at different crossroads
it supports a single authority
it professes a single view to reign the earth
it demonstrates how it produces the knowledge
with unjustifiable righteousness
to bolster its 'virtual state'
by using man-made indefensible representation of knowledge
by suggesting only one way of knowing 'its singular world'

After completing two poems, *Time and Curriculum* and *Self and Other*, I sought some advice from Peter for writing commentaries. Peter advised me that I could elaborate my experience of the moment of writing the poems. However, I wrote the commentaries differently: the commentaries tend to be an account of the background for writing the poems. For the commentary of *The History I Read*, I am quite undecided about the nature of the commentary although I have planned (roughly) to connect my three experiences: writing poems, writing the commentary and studying the history of mathematics.

As I started to recollect my memory of studying the history of mathematics in my masters' studies, I felt a crisis of depicting the whole range of experiences in these limited pages. Perhaps, writing about my experience of reading *the* history can construct another project report. Indeed, it could be a lengthy process to write about my reflection upon each chapter, each mathematician and each genre of

mathematical knowledge. However, I have to write about my (summary) experience that emerged at the level of poetic representation.

My fingers stop from time-to-time because of the crisis of choosing an appropriate word for describing my feelings. I cannot say completely that I am writing for you, nor can I deny that. Deleting and retyping the words could derail my initial plan of writing. In writing, I have lost the way in the hidden jungle of typestrokes. Coming back to my planned track could be again a difficult task: I might need to wait for a while; I might need to ponder my plan; and I might follow the plan that is being constructed as my fingers (unsystematically) move around the keyboard. Indeed, writing turns out to be an effective means of depicting my experiences: it becomes a means of working between three experiences: the experience of remembering past experiences, the experience of writing and the experience of reading.

I wrote the poem, *The History I Read,* according to my experiences of the masters' course on the history of mathematics. It represents a way of mapping between my past experiences and my present standpoint. For me, the process of mapping is a means of connecting between *reflection on-action* and preparation for my future. Reflecting upon my experiences echoed in me the sentence, *without rigorous proof and universal mathematical representation, new branches of mathematics cannot be accepted within its community.* It shaped my understanding of mathematics as an authoritarian and a dogmatic subject. I did not ask any questions of the texts represented in the history course because there were very few opportunities for a reader to construct his/her own meaning. It may not be a great surprise that the representation of history of the heroic Western mathematics was full of prideful statements supporting its prescriptions and rituals in order to maintain its centuries-old authoritarian regime. In retrospect, prescription and power are major tools for manifesting the ideology of history itself.

Writing is purposeful: Writing a history is to propagate the ideology embedded within it. I am writing (though my voice is too low) to dispel (i.e., to caste off the spell of) the myth of traditional history of mathematics. Needless to say, it is important to know the interest of the author who claims something to know: Whereas

I am writing for culturally contextual mathematics, the Western historian might have written for ideological propagation of single view of the history of European mathematics.

Although my history of mathematics teacher (only) introduced the term 'ethnomathematics' as mathematics of people, the notion of an ethnomathematical standpoint could help view the history of mathematics from an alternative perspective. Such history(s) could hold different epistemological and ontological standpoints from that of the official mathematics. Furthermore, the representation of historical events and times is more problematic while it subscribes to the metaphor of *history as out there.* Specifically, history is rather constructed in order to serve different types of interests of concerned communities. Perhaps, the one-sided depiction of the evolution of *the* mathematics could serve the interests of a small group of people who intend to hold the authority of *their* mathematics. For me, the hidden intention of my course, *Foundation and Historical Development of Mathematics Education*, was to prepare a critically unaware mass that would never question the ownership of the historical facts, knowledge and authorship. In retrospect, depicting Western mathematics as the holy knowledge for the whole world seems to undermine local mathematical knowledge(s) which might have more meaningful representational systems for local people. Similarly, uncritical acceptance of knowledge as though it is free from 'power' could be an indication of preparing a group of clerks for the conventional mathematics. Even within the history of mathematics, I read that the concept of Pascal Triangle was evident before 3000 BCE in Eastern civilisations (Eves, 1969). Similarly, many mathematical concepts that involve oblique triangles and multiple measurement systems existed since antiquity in our cultural milieus. Perhaps, the intention of these canons was to enculturate *others* according to the culture of elite mathematics. However, I did not raise any questions about the ideological, cultural and political influence of such history. In retrospect, I need to raise more questions: Have we completely been transformed according to *others* belief systems? Could I still hold my cultural beliefs although the mathematical knowledge, which I learned, has embedded within it different ontological beliefs from mine? How could I promote *my/our* local mathematics in the context of a monological pedagogy of official mathematics? Why

did we not explore our own (folk) history of mathematics? Why did the course exclude our ancestors' construction of mathematics in their astronomy, wood carving, cloth knitting and in many other cultural activities?

CHAPTER FIVE

MULTIPLE IMAGES OF SCHOOL MATHEMATICS CURRICULA: EXPERIENCES OF A TEACHER EDUCATOR

Curriculum, voice and student centeredness

'Bell, Parallel and Perpendicular Lines'

"These are parallel lines," Dharma continues to explain to the class, "Because they never meet if they are produced indefinitely." Sitting on the last bench of the grade-six room of Mahendra Middle School, I am making notes of the classroom activities—a day-to-day routine of classroom observation. "Why is he explaining all this stuff rather than conducting a discussion?", I murmur to myself. However, it is not a time to comment about his teaching. I make a note for post-conferencing: "too much teacher talking".

"Why don't I tell him that his teaching is too bad? Why don't I conduct an exemplary activity?" A wild idea appears in my thinking and goes quickly as though my superego suppresses the egocentric ideas. Again, Dharma seems to be less confident about his teaching. I make another point: "lacks clear explanation"

It seems to me that Dharma tries to read my face. Perhaps, he reads that I am not happy with his activities. Gradually, he moves to each student and starts to ask him/her to define parallel lines.
"They never meet when produced."

Most of the students produce the definitions. Dharma seems unclear about the student-produced definitions. It seems to me that he just tries to prove that his students can absorb his definition very well. I make another note: "more like a deductive approach."

Dharma draws some pairs of lines and asks the students to identify which are parallel which are not. However, the problems seem to be obvious for the grade six students. Most of the students finish them in less than five minutes. He tries to check each of the students' "class work"—an unjustifiable activity for me. I make a note again: "students do not seem to be challenged intellectually."

He opens the 'math textbook'. "We will start a new topic," Dharma informs them. Some of the students seem to be busy talking with their bench-mates. A nearby student, who is sketching something, draws my attention. "What are you drawing?", I ask quietly. "This is a bell," replies the student. Dharma starts to teach the topic of 'perpendicular line'. I again look at the boy's drawing. He draws two concentric circles depicting the interior and exterior edges of the bell. As Dharma asks all students to be quiet, the boy raises his hand and invites his teacher. I am rather curious. "Are these two lines parallel, sir?", the boy asks pointing to the picture. "They are not lines. They are circles. This is out of the topic," Dharma replies. "But they never meet sir!", the boy contests again. Dharma returns to the blackboard. The boy now gives a final touch to his drawing by sketching some vertical (cf. perpendicular) lines connecting between the node and the circular edge of the bell (Figure 5). Perhaps, he will contest again why the vertical lines are not perpendicular to the edge of the bell.

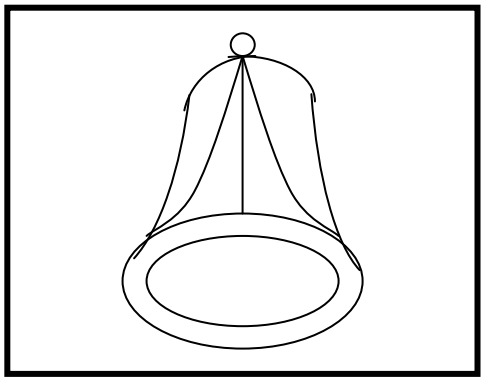


Figure 5: A sample sketch of Bell

I shall start this commentary with T. S. Elliot's stanza *[Modernity] brings Knowledge of word but ignorance of the Word* from his poem *Choruses from the Rock* (cited in Slattery, 1995). While constructing the plot of the story, *Bell, Parallel and Perpendicular Lines*, my focus was on the depiction of my experience of observing lower secondary classes which were less focussed on the meaning of the activities and student voices. I am not sure whether the story can be read to all readers from this perspective. However, as the writer of the story, I will present my commentary from two perspectives: as a writer, as the first critical reader.

As a writer

I have mentioned the intention of writing this story in the foregoing paragraphs. Specifically, writing the story was to express my concern about the teaching-learning situation in many lower secondary/secondary classrooms of the government schools of Dhulikhel Municipality. In my observation, most of the mathematics classes tend to be 'teacher-probed' student-centred rather than dialogically student-centred. Specifically, the mode of teaching adopted by teachers is to explain something first and to ask some (pre-designed) convergent questions in order to probe their success in teaching.

The story may have been imbued by my 'present perspectives' because my experiences and observations, right now, have become past. Furthermore, I agree that I have demonstrated my predisposition toward the nature of teaching and learning while depicting this situation. It would be equally true to me that we all have bias and dispositions. However, I hold the view that we need to use our bias and dispositions for the well being of many people. In essence, the story is no longer free from theories; rather it has embedded theory(s) as a referent for viewing many teaching-learning phenomena.

My purpose in writing this story is not to blame any particular teacher or group of teachers. Rather, I am trying to put the classroom context and the teacher character's role in a bigger picture. In saying so, we need to understand that most of the classroom activities that I observed were guided by externally mandated curricula and textbooks. In the textbook, there was no bell and there were no examples of *concentric (curved) parallel lines*. Perhaps, the teacher was oriented to follow the curriculum document as though it was the only ends of teaching. However, a creative teacher could think beyond this *slim document* in order to address the complexity of teaching. S/he could take many emerging issues into account in order to make their teaching more student oriented: s/he could take the students to a Hindu temple to study the geometric properties of the bell; and s/he could take students to visit a Buddhist temple to observe Buddha's symmetric face. In essence, a creative teacher could conduct many meaningful activities regardless of the prescriptive, monological nature of the curriculum process.

As the first critical reader

There may be a disagreement that a writer's perspective cannot be different from being a reader. To some extent, it is true that a writer can be affected by his interest in writing the story and he may read it from that spirit as well. However, there is another possibility, that reading is a different experience from writing a story.

Reading my story, I revisited my role as a teacher educator and asked some critical questions of myself. Was my role adequate for improving the situation? How did I help the teacher to be more inclusive and dialogic in conducting activities? To what extent did the teachers benefit from my ways of supporting them? I could say that my activities were absolutely excellent; I would bring so many *proofs* to probe my superiority. However, I read the story differently. I answered critically the question of myself. I tried to see my weaknesses in my *situatedness*, as well as my strengths. I reflected upon the unworkability of some of my suggestions in the classroom contexts and my success in adapting new approaches in collaboration with local teachers.

My posture in writing the story has not changed drastically while reading the story. However, I am interested in implicit and non-obvious differences between my two roles: the writer and the reader. Perhaps, my role as a reader can be more critical while the writer should be more responsible. A reader may not set out any specific limitations while the writer should frame a certain edifice. As a reader, I can see a trail of authoritarian direction in Dharma's classroom activities. From this perspective, the teacher was made powerless because of his minimised role in the curriculum decision-making process. Similarly, the students were even more powerless because of the seemingly expert- and teacher-oriented classrooms. My power could be (implicitly) playing a role in establishing control over the classroom activities, as evident by the teacher looking suspiciously at the observer's face. However, the power of my gaze was directed less at indicating my own authority and more at considering improvements in teaching.

'The Death of Silence'

"This is enough for today because the bell has already rung," I told the grade eight students. They smiled and started to pack up their textbooks and notebooks. "I will see you later," I spoke in the tune of a farewell. Then, Krishna and I left the classroom with plenty of emerging issues about teaching and learning. "Can we find a quiet place in the staff room?", I asked Krishna. " Perhaps," he replied. I greeted the head-teacher and moved to the staff room. As I was waiting for Krishna, I clearly heard the head-teacher asking the attendant to bring two cups of tea.

"How was my class, Krishna sir?", I asked curiously. "I liked the class. Specifically, your ways of clarifying the meaning of null set, sub-set and universal set were new to me," he commented. "Did you find anything worthwhile to adopt in your own day-to-day teaching?", I asked. He then opened his notes. "I am concerned about the flexibility you demonstrated in conducting discussion activities," he continued, " Perhaps, with these activities we may lose control of the students." "What do you mean by 'losing control'?", I sought clarification.

"For me, students should be told 'wrong' or 'right' for their responses. However, you did not tell explicitly wrong for the wrong responses," he sought my clarification. "Thanks for your comment, " I continued, "However, by saying 'you are wrong', we can discourage them from being active participants in learning. Perhaps, it would be better to use diplomatic and encouraging language. We may not be one hundred-percent correct and students may not be completely wrong."

"I have another concern that you took too long to define the different concepts of set," he added, " For me, defining everything in the beginning helps them to be clear about what they have to understand." I suspected by now that this discussion would continue to be an exchange of parallel ideas. However, I could not discard his voice because I was there to help improve his practice. "That would be a good strategy for the university students because they can make sense of definitions, theorems and examples. They can learn by themselves. However, for the students of

eighth grade, it could create confusion. If we help them to generate definitions by themselves then they may think that they have a sense of ownership of those definitions; they nurture such definitions more carefully than we-generated definitions. For me, our role is to develop their *agency of participation* rather than to make listen to our ideas, " I tried to clarify.

By then two cups of tea had arrived. We became silent for a while. I again insisted that we talk about my classroom.

"Your method seems appropriate for improving student learning. However, we may not be able to finish the course in time if we use these methods," he still resisted my ideas. " Have you planned for the whole academic year? How many actual periods do you need to finish this course?", I tried to be practical. "Yes, we have prepared the yearly plan for each class. It seems that we may need approximately one hundred eighty to two hundred teaching hours to finish the course," he made a rough approximation.

"It is not that bad, " I commented. "No sir, this is just tentative. Often, we need to repeat the topics frequently. So finishing the course is a nightmare," he reacted quickly. "Have we informed the students about these plans?", I asked.

"No, should we?", he requestioned. " It would be better if we involve the students in planning the topics. If this is not possible, we can negotiate later in order to make them responsible towards their learning," I clarified. "Yes, we can do that," he affirmed.

He then sought my suggestion for teaching other topics such as relation, function and geometric transformation. As we discussed together, he started to demonstrate his dissatisfaction over the school mathematics curricula and textbooks. " Why do you think these curricula are bad?", I questioned. " First, it is very hard to finish the content in time. Second, the curriculum change occurred without consulting schoolteachers. The CDC (Curriculum Development Centre) may say that it has included teachers. However, the names mentioned in the curriculum documents are handpicked. Some of the teachers told me that they have no idea how their name was printed," he nodded.

It was my opportunity to bring him on line. "Why don't we argue for teacher, student, and parental participation in the curriculum process? Why don't we say that the curriculum decision bodies need to take account of the teachers' ideas as well as parental expectations? Why don't we actively involve students in the curriculum process?", I persuaded him to broaden his view. " I didn't understand the notion of

involving students in the curriculum process," he queried. " My focus is on making students active in and responsible towards their learning. It is a most important part of the curriculum process. More than that, we can ask secondary school students about their perception of mathematics. We can ask them to provide feedback on our teaching, can't we?, " I attempted to elucidate.
"It seems to me that the death of silence is quite likely," he summarized.

The story, *The Death of Silence*, represents my experience of working with secondary mathematics teachers during the first half of the year 2000. Demonstrating (in the form of co-teaching) classes/lessons was one of the ways of improving teachers' practice and a means of reconceptualizing my personal pedagogy. I continue to hold the view that this is an effective means of constructing contextualised pedagogy, particularly, after connecting my experience with Wolf-Michael Roth and Kenneth Tobin's (2003) explorations of co-teaching in an urban school. Indeed, knowing their explorations of *pedagogical praxes* has stimulated me to collaborate further with schoolteachers (and students) to enrich my understanding of pedagogical landscapes. Furthermore, working with experienced teachers can help me understand their wisdom of practice, and can give me a rich understanding of practical knowledge about teaching and learning.

The story has raised a number of issues about curriculum and pedagogy. However, I will discuss two main issues. First, I will discuss the image of curriculum as other's text and its relationship with classroom teaching. Second, I will discuss the notion of voice in the context of the curriculum development and implementation process. Furthermore, I will draw some possibilities of developing shared ownership in school mathematics curriculum.

Curriculum as Other's text

'He is neither maternal nor paternal' is a famous Nepali proverb that is used to signify someone who is not a connected person. Indeed this proverb helps conceptualise the meaning of Self and Other in our context. Perhaps, (de)constructing the proverb gives a notion of *collective self* rather than a *personal*

self. I am trying to use the analogy of Self and Other in order to explore the *teacher character's* image of *curriculum as Other's text*. In my story, the teacher expresses his dissatisfaction over the curriculum because of the mismatch between the available time and the amount of subject matter. What does this imply? Does not this imply the teacher's conceptualisation of curriculum as Other's text? How can the text be made a Self-text?

Henry Giroux (1992) points out the need to identify Self and Other while crossing borders (i.e., understanding different and often contrary worldviews). I agree with him that the dichotomy can be expressed implicitly or explicitly in the context of a decision-making process. Does this mean that curriculum is a political text? Is a curriculum a reflection of power? My story indicates two basic contexts that reflect *curriculum as a political text*. The teacher's concern about his non-represented voice in the curriculum reflects that he is not sharing ownership of the curriculum: The curriculum texts do not belong to him, as though they are someone else's texts.

That Krishna, the character of the story, mentioned that it was not necessary to share his plan with his eighth grade students represents the teachers' attitude of neglecting their students' voice (i.e., Other). Students may view the subject matter, planning, day-to-day activities and so forth as not belonging to them. Indicatively, the lack of *ownership sense* may create a barrier to participating actively in the classroom process. Does not this reflect the context of curriculum as Others' text? Discussing this image of curriculum, we may recall the technical process of curriculum development. In my experience, a general trend is that a group of experts, who hold the power (educational, political and so forth) in contemporary society, prepare school curricula. In this way, curriculum decision and implementation seems to be an anarchic process in that (i) who decides a curriculum is not necessarily the person responsible for implementation and (ii) who does not share the decision process is to be responsible for its success and/or failure.

Searching for some possibilities for sharing ownership in the Other's text can give an alternative metaphor of curriculum as a *two-way-street*: a continuous dialogue between Self and Other. The dialogues between experts and teachers, schools and

parents, teachers and students can help enlarge the narrow circumference of a curriculum. In my experience, the perspective that sharing mathematics curriculum with schoolteachers is impractical because they do not understand the 'new content' is pervasive within our expert community. Implicitly, this belief can drag us down to the notion that mathematics is inaccessible to a large part of the population. Why are we teaching this subject? What is the use of this subject? Are we imposing Other's text in the name of mathematics? Are there any possibilities of reconceptualizing mathematics from our perspective? How long do we (and our students) study mathematics as Other's text?

Voice

To some extent, the issue of *voice* is concerned with political processes (e.g., decision making, policing). Krishna's concern about the absence of his voice in the mathematics curriculum indicates the univocality of the curriculum text. Here the notion of voice is intertwined with the image of curriculum as Other's text. However, I will discuss the issue as a means of developing a critical pedagogy of mathematics.

I agree with Schubert (1986) who interprets the curriculum *field* as a voice of professionals working in the field of curriculum development and pedagogy. Specifically, the intertwined relationship between curriculum and pedagogy can be conceptualised from the corresponding connection between a curriculum image and its subscription to a particular pedagogical standpoint. For instance, curriculum as a single voice can promote a monological and an authoritarian pedagogy, whereas curriculum as multiple voices can help construct a critical, dialogic and transformative pedagogy. In my story, Krishna's focus on subject matter is not only for his own sake but also for the sake of the curriculum designer(s) who regard mathematics curriculum as a collection of (already prepared) subject matter – a unilateral voice of the mathematics community. Does this mean that we should not listen to the mathematics community? Do we need to teach whatever we like to teach? In my perspective, we have listened too much to the subject community rather than listening to the voice of the others. '*Listening to multiple voices'* can encourage each individual to reflect upon his/her school life. Why do we not speak as a human

rather than a mathematician or mathematics expert? What are our children's future needs?

Understanding multiple voices is possible while we identify differences and similarities between them. In my experience, voices are raised when a group or a person is felt unheard and un(mis)represented. Metonymical representations are pervasive in our educational milieus as teachers represent their classes by a group of students and experts try to represent the curriculum by means of their unilateral perspective. Reconceptualizing student-centred pedagogy (but not a behaviouristic-normative) requires us to embrace *polyvocality* by encouraging both supportive and dissenting voices.

Curriculum and cultural enactment

'Storying Variable and Constant'

"Once upon a time there were two kings: one was very energetic and the other was very lazy. Being lazy the king rarely walked from one place to another", Sita paused her story for a while. "How many kings were there?", she tried to make a recall of the story.
"Two, miss, " replied the students.
"The energetic king used to travel from one place to another each day," she continued, "to know whether his people were doing well. Walking from place-to-place he did not know exactly how many kilometres he travelled." She drew a path-like line and put small dots in six places to denote the king's recent six-day travelling distances. "The king's secretary made a written notice that the king travelled 🏠 kilometres each day during this week. 'What do you mean by 🏠 kilometre Secretary?', asked the king. 'Your majesty, you have been travelling each day with different distances. So I tried to make a general statement. Your Majesty you travelled five kilometres on Sunday; six kilometres and twelve metres on Monday; four kilometres on Tuesday; eight kilometres and one metre on Wednesday; seven kilometres and two hundred meters on Thursday and five kilometres and three hundred metres on Friday.' After this, the secretary drew a table of the king's travelling distance. Can you draw that table as well?", she asked the students. "Yes miss, " replied the students. Sita also drew a table on the board depicting the

king's daily travelling distance. She observed her fifteen students' task. "If I say the king travelled 🏠 km on any day of this week, how many possible answers can you make instead of the placeholder🏠? For instance, one answer may be the king travelled five kilometres," she exemplified. "Six different answers miss," a group of students answered quickly. Sita asked some of the students why they think there would be six answers. Most of them said that the king travelled on six days.

Sita started to tell the story of the lazy king. "The lazy king never travelled to know about his people in his lifetime except for once to see his mother-in-law. He travelled one kilometre at that time. His secretary made an announcement to the public that the king travelled one kilometre," Sita ended the story.

"Why did the previous king's secretary use a symbol rather than a number? Why did the lazy king's secretary use a number?", she raised these questions. "Miss, the energetic king travelled more kilometres than the lazy king." "There was more than one number, miss."

"The lazy king travelled only one day."

"The energetic king's secretary has many numbers."

"The lazy king's secretary has only one number."

These were some of the responses she wrote on the chalkboard. "Yes the energetic king's secretary has many numbers, so he used a symbol. However, the lazy king's secretary has only one number. He didn't need to use any symbol," she summarized.

"Do you have one of this type of story?," she asked the students. "Yes miss I have," one student raised both hands. She allowed her to tell a story. "I walk everyday from my home to school but my little brother can't walk frequently. I saw him yesterday walking just two leaps," she smiled. "Yes, very good example. This is Rita's brother and this is Rita (she drew two portraits). He just walked 2 leaps yesterday. Rita walks everyday. How many leaps do you walk Sunday?", she asked. She negotiated with Rita that Rita walked 101 leaps on Sunday, 204 on Monday, 89 on Wednesday, 109 on Thursday and 50 on Saturday.

She wrote a sentence: Rita walks __leaps each day. She asked, " What would you like to write in the blank space?" One of the students suggested a home-like symbol. Rita asked other students about a symbol to be written for that. Most of the students suggested the symbol which she used for the previous story. "We can use any symbol for this," she continued, "let me write a '😐' in the space." All the students smiled at the symbol. "How about Rita's brother? How can you write this one?" "Rita's brother walks 2 leaps miss," told a student.

In the meantime, the bell rang. I followed Sita miss to know about her next class.

The story, *Storying Variable and Constant,* has been constructed according to my experience of observing several primary school classes in the government schools of Dhulikhel Municipality between the years 1999 and 2001. As a writer of this story, I have tried to depict some local teachers' creativity in enacting mathematics curriculum by using local cultural tools. From my perspective, deconstructing such culture-embedded activities can help broaden the narrow meaning of curriculum, *curriculum as a document.* Given this, I shall present my commentary by exploring two issues. First, I will discuss how local cultural tools are helpful in order to enact a mathematics curriculum more meaningfully. Furthermore, I will explore some possibilities of the use of story as a culturally viable tool in the primary schools where I worked as a teacher educator. Second, I will further elucidate some possibilities of involving local cultural tools in primary mathematics curricula.

It seems to me that the official notion of the term 'curriculum' is a document that embodies objectives, a list of content and some prescriptive teaching methods. Furthermore, such an image of curriculum rarely allows teachers to construct a context appropriate curriculum. Specifically, addressing the local cultural issues in our plural cultural landscapes may require an inclusive image of curriculum that can help integrate local cultural resources (e.g., different languages, cultural artefacts, folklore, myths, and religious rituals) in order to enact school mathematics curriculum. In my story, the teacher character can be an exemplary teacher for using a story in order to teach such complex mathematical concepts.

There may be two basic aspects, *why* and *how,* to consider for an effective and meaningful integration between local cultural resources and school mathematics curriculum. For me, the aim of such integration is to make mathematics curriculum more justifiable and meaningful for our school students. The continuous journey of *the energetic king* can metaphorically represent a way of integrating local cultural resources in a mathematics curriculum. Specifically, we need to identify and revisit our millennia old cultural tools in order to find out their educative implications. We

can find many cultural tools which can help make mathematics more meaningful to the day-to-day life of the students. Perhaps, in crystallizing the difference between variable and constant, the story can be regarded as an educative tool that is more powerful than activities (perhaps translated from foreign experts) suggested by curriculum experts.

The image of curriculum as a centrally prepared document may be problematic in the context of multiple cultural practices of the population. I am not saying that we need to stop producing a curriculum document: instead, we need to revise our understanding of curriculum; and we need to construct and adapt an inclusive and encompassing meaning of curriculum. Why do we not think of curriculum as cultural enactment? Why do we interpret curriculum as enacted text instead of as passive, bookish and unchangeable text? Simply speaking, making a curriculum as *dynamic text* requires voice (e.g., speaking, writing, interpreting, etc.) and movement (e.g., walking, playing, writing, drawing, etc.) which can be regarded as cultural activities. If such cultural activities were guided by a static notion of curriculum, the meaninglessness of subject matter and activities would be likely to appear.

Since cultural enactment is essential to make mathematics curriculum meaningful, storytelling can be a viable cultural tool for teaching many difficult mathematical concepts at the primary school level. Specifically, a storytelling approach involves analogies, metaphorical images and a culturally viable fictional plot—mathematics can also be regarded as a fiction. Perhaps, many unexplained concepts can be explained through metaphors, analogies and culturally viable fictions. For this, students and teachers construct and share their stories. Creativity and awareness on the part of primary schoolteachers is essential in order to enact curriculum by giving contextual meanings of concepts through stories.

I am not suggesting that storytelling is the only way of enacting curriculum at the local level. Instead, I am saying that storytelling is a powerful means of making sense of difficult concepts by constructing student-friendly contexts. Perhaps, encouraging teachers to use stories as a means of integrating local cultural milieus requires us to rethink our prescriptive approach to teacher education. You may raise

a question: Why are you bringing up the issue of teacher training in discussing curriculum issues? For me, issues about school curriculum are inextricably intertwined with the ways we prepare teachers, the ways we advocate pedagogical standpoints, and the ways we suggest teachers enact curriculum, irrespective of local contexts.

It would be contextual to use the *then-sky-became-clear-after-getting-rid-of-devil-like-thick-cloud* metaphor, which is very famous in Nepalese folklore as a means of making happy-ending stories, as a means of making 'happy-ending' teaching-learning activities. How many of our teaching-learning activities have turned out to be a happy ending for most of our students? Perhaps, we need to be introspective about our day-to-day teaching activities and reflect upon our classroom milieus. As a teacher educator, I have heard plenty of teachers' complaints about the textbooks and curriculum not addressing many contextual problems. I have observed many classes with a majority of tragic-ending activities. Perhaps, making happy-ending activities is to make them inclusive, culturally appropriate and locally enactable.

Curriculum, experts and teachers

'They Don't Have Any Ideas About Curriculum'

It could be any day in March 2000. Gunaraj and myself are about to reach his office. "Do you think the secondary mathematics teachers need more curriculum orientation training?", he asks for my decisive answer. Gunaraj, a teacher educator, coordinates the project activities that aim at improving the teaching-learning situation in the government schools of Dhulikhel municipality. "Yes, they have plenty of questions about the curriculum, especially about the content area and textbooks," I reply.

By then we reach his office. He opens the main door and requests me to take a seat. "Let's propose a date for the orientation session," Gunaraj puts a calendar on the table, "What about the first Monday of April?" "It's fine," I agree with the date. "I will discuss it with the teachers," I agreeably propose.

"By the way, what are their complaints about curriculum?", he asks for a specific answer. "Subject matter, sequence, timing, the textbooks' insufficiency in fulfilling curriculum goals, curriculum decision process, etc," I read these points from my diary. "What do you think about these problems?", he asks for my opinion. "Perhaps, there are some problems in curriculum," I continue, "Specifically, teachers are not yet ready to cope with the changes."

Gunaraj, then, orders two cups of tea. "Which school are you going to visit, sir?", he asks. "Deurali Secondary school," I reply. "Teachers are also full of negative attitudes," he opines. "Yes, that's true, but we need to take account of their ideas," I continue, "They are the 'first hand implementers' of the curriculum." "For me, the definition of curriculum itself is a problematic issue," Gunaraj maintains, "Each curriculum specialist has his/her own definition. For some, everything turns out to be a curriculum: even activities performed outside the school seem to be a part of school curriculum." I show my agreement with his ideas: Perhaps, it is a way of sharing commonalities with a degree of diplomacy.
"Despite the broad ideas of curriculum, the teachers have been regarding the textbooks as the main curriculum," I add, "It can be one of the examples of the problematic relationship between theory and practice." We do not speak for a while. Gunaraj checks his email.

"Yes that's true. Recently, I have read an article about English language curriculum. It has exemplified several types of curriculum. Curriculum as syllabus, textbook, lesson plan, activities, objectives and so forth," he affirms, "Does this seem to be similar with the concept of mathematics curriculum?," " Yes, but mathematics has been depicted as more content based than activity oriented. Teachers' main concern is the sudden change in content areas as though they are more important than the teaching learning activities," I clarify.
"Oh, we are yet to confirm about the expert for the session. Who do you think is appropriate?", Gunaraj seeks a name. Perhaps, we need to invite Mr. Clout. Gunaraj checks his phone number. He indicates me to call him.
"Hello"
"Hello. May I speak to Mr. Clout?"
"Sorry. He is on leave. Perhaps he may be at his home. Do you have his home number?"
"I don't have it. Could you give it to me?"
"01 xx xx xx"

"Thank you"
I dial the number given by the personnel officer of the Curriculum Development Centre.
"Hello"
May I speak to Mr. Clout?"
"I am here. By the way to whom am I talking?"
"I am Balchandra, working as a teacher educator in Kathmandu University. We have organised a mathematics curriculum orientation session as per the demand of the secondary school teachers. We have decided on you as an expert for that session. What about your time for the first Monday of the next month?"
"Thank you for your invitation. But I am sorry to say that I have stopped discussing the issue of curriculum and textbooks with teachers. They don't understand anything about curriculum. It is just a waste of time. It would be better to organise a session about how they have to teach a particular content in their classroom."

"Oh I see. Thank you very much for your time." I hang up the phone.
"What does he say?", asks Gunaraj. I tell Gunaraj what Mr. Clout said about my invitation to him as a curriculum expert. Perhaps we need to think about other people. "Oh, I have to be in school in fifteen minutes," I add, "We will discuss this tomorrow". Gunaraj accepts. On the way to school, I am still in confusion about the sacred nature of expert-defined mathematics curriculum.

The vignette, *They Don't Have Any Idea About Curriculum*, portrays an expert's perception about teachers' understanding of curriculum. Given the context of the vignette, the expert seems to be referring to theoretical knowledge about curriculum while teachers' complaints seem to be related to their day-to-day practice of teaching. Consequently, the vignette also indicates a situation of the superiority of theoretical knowledge over burgeoning, though unused, practical knowledge of schoolteachers. With these considerations, I will try to explore different curriculum images from the perspectives of an expert and a teacher. In doing this, I shall also explore some practical considerations of incorporating curriculum as experience and *currere* as a means of exploring student-centred pedagogy in school mathematics.

Expert's curriculum image

The expert character, Mr. Clout, clearly asserts that schoolteachers do not need to understand the notion of curriculum. Though he does not mention explicitly what he expects the teachers to understand, he indicates that the subject of curriculum is not related to teachers. Who should know about curriculum? Where is the field of curriculum? Is curriculum separable from the day-to-day life of teachers?

My answers to some of the questions have been engraved within the commentary of the story, *The Death of Silence*. However, I shall try to deconstruct the hidden meaning of the expert image of curriculum embedded in this story. It seems to me that Mr. Clout has defined his curriculum as a subject of academic discussions and bureaucratic decisions. Perhaps, the prescriptive pedagogy holds the idea of separating curriculum from the day-to-day lives of teachers. What can be Mr. Clout's curriculum metaphor? How does that metaphor affect the day-to-day lives of Nepali schools? For me, the expert image of curriculum can be represented by a metaphor of *hidden treasure*. It implies that the treasure is kept (secretly) within the community of certain experts. Similarly, the market metaphor can be an ensuing metaphor of the former one. What does this indicate? Perhaps, the curriculum decision process can be explained as bringing the hidden treasure into the unchallenged market. Implicitly, the consumer of the monopolized market cannot get more than one choice, as the seller defines the destiny of the customers. Opening this *divine formula* of curriculum devolvement to the teachers could be unethical for Mr. Clout.

The pedagogy of such a curriculum image can easily be drawn as *teaching for tests*. Using only *sit-for-test* 'exams' as a means of assessment can give an extreme authority to a certain group/person. Such an assessment system empowers the powerful and overpowers the powerless. Using the same tools of assessment for rich to poor, urban to rural, resource-rich to resource-restrained schools is to promote success for the *privileged* and failure for the *deprived*. In essence, the pedagogical implication of the expert-oriented image of curriculum is likely to follow the Pavlovian *dog-training model* of teaching.

Teacher and multiple curriculum images

In my experience, dedicated teachers should have genuine complaints about curricula because they have to grapple with the situation; they are the real implementers of curricula; they have to make meaning from externally mandated (meaningless) curriculum; and they have to share maximum responsibility for the failure of their students as a result of a narrowly justified assessment system. Can Mr. Clout's notion of prescribing 'appropriate teaching methods' help improve this situation? What curriculum images can help improve the practice of teaching?

Multiple horizons of thinking are likely to follow while exploring the subject of improving teaching and learning. However, I intend to discuss this issue by exploring the relational implication of curriculum images to our day-to-day teaching-learning activities. Revisiting Gunaraj's multiple definitions of curricula may encourage us to open multiple curriculum images. Let us start from traditional images. *Curriculum as subject matter* is likely to restrain the teachers to improve their practice by empowering the role of *mythicised objects* (e.g., subject matter, formula, expressions, symbols, etc.). The authority and ownership of this curriculum lies with the external agency (e.g., subject community, subject experts) rather than with the teachers and students. How about the role of *curriculum as cultural reproduction*? Does it help teachers to transform their students from being caged in the uncriticality of the subject culture? Perhaps, the prevailing mission of this image is to prepare students who are culturally loyal to the supremacy of the subject matter.

Of late, alternative images of curriculum have been reconceptualised elsewhere (e.g., Jagodzinski, 1992; Schubert, 1986; Slattery, 1995). What can such images be? Let us take an example from our own life as a teacher or educator or a *pedagogic being*. We acquire plenty of experiences by helping others' learning and knowing processes. In particular, a teacher/educator is likely to acquire educative and pedagogic experiences by helping (and rearing) her/his students to learn. Parental experiences of nurturing their children are pedagogical, as they have to strive for socializing their child. However, such experiences are 'out of the box' while dealing with the traditional images of curriculum. You may argue that there is provision for selecting *learning experiences* in the Tylerian model of curriculum development (cited in

Slattery, 1995). But who selects such *experiences*? In my experience, they have been interpreted as pre-determined topics of subject matter which are generally selected by a group of experts. Here, my focus of *curriculum as experience* is to explore our teaching learning landscapes beyond the narrow frame of subject-based pedagogies (e.g., integrating different subjects, problem-based learning, thematic learning). Let us awaken teachers to share their success and failure stories. Let us encourage them to share their first day of teaching. In essence, curriculum can be made meaningful by considering teachers' wisdom of practice.

Who, why and how is a teacher teaching mathematics? I raise this question in order to search for another curriculum image. Here, the *who* seeks the person's self-identity as a teacher. Is he well prepared to teach a particular subject? What are his/her values? How are such values manifested in teaching? Do they need to be reconstructed? Justifying his/her perspective of being a teacher comes under the why category. He/she needs to explore his/her experiential and historical perspectives to justify the *being*. Indeed, this curriculum is not simply a collection of experiences: Rather it seeks multiple interpretations of lived experiences (van Manen, 1991). This image, known as *currere*, can give a basis for the professional development of teachers by taking them close to their practice. Instead of blaming teachers for not being able to hold the expert view of curriculum and teaching, helping them to identify their own strengths and weaknesses can be a better option for improving pedagogic practices.

Mathematics, interest and power

'Sorry Sir! The Boy Is Erratic'

It could be any late morning of August 1999. I am in the grade-nine room of Birendra Memorial High School in order to demonstrate student-centred teaching as per the request of the local teacher. I have brought some coins and platonic hexahedron (cubes) in order to exemplify the official meaning of the term 'probability'.

I start my lesson with some statements such as: There may be a 50% chance of being failed in mathematics; there is likely to be a –3 chance

of having a new teacher in the school; there may be a chance of 0.3 of being successful in the math test; the chance of wining a game is 10, and so forth. My intention is to provide some counterintuitive examples of the nature of probability numbers. I ask the students to identify 'the sensibly correct statements' from the given ones. All students, at least with a complementary statement, seem to understand that the statements with a negative number and a whole number are unlikely to be used in our day-to-day language.

Summarizing the first activity helps me to conclude that the probability numbers are simply the decimal numbers inclusively ranged between 0 and 1. "Why Zero and One sir?", asks a student. Their teacher seems to be cautious that his students might raise unnecessary questions. I write two probability events: 'the chance of a boy student studying in a ladies school' and 'the probability of the height of Mt. Everest as 8848 meters'. They discuss and are convinced with the impossible and certain probabilistic events.

"Do you have some 50 paisa coins?", I ask them. More than 20 hands are raised. Their teacher is helping me to make groups. Five/six students are assigned to work on each of the six tables. I ask them to toss their coin and record the 'toss result' in a table (I drew a format on the chalkboard). "What do H and T stand for sir?", asks one of the students. "Actually, Head and Tail," I respond. "But our coins do not have head and tail?", contests the student. "You are right. Let's denote H for cow and T for trishul (similar to trident). I ask each group to toss the coin 50 times and record the occurrence of H and T. I conduct this activity because the concept of empirical probability is a primary focus of the curriculum.

I collect the frequency of H and T from each group of students. Luckily, H occurs 49.5 % while T occurs 50.5%. By now, the students seem to be ready for the theoretical statement that the probability of H and T occurring is equal to half. Though I am not happy with the sequence of the subject matter, as I have taught the same content in a university class, I have to demonstrate to the class according to the curriculum and the textbook.

We extend the activity to the case of a dotted cube. I ask them to estimate the probability of occurrence of the 1, 2, 3, 4, 5 and 6-dotted faces while tossing such a cube. I give one cube to each group to observe

it because most of them are unfamiliar with the dotted cube. I visit each group and persuade them to think in light of the Head and Tail activity. I think that persuasion is essential as they might be confused by the definition- based concept of theoretical probability.

In the meantime, I see a raised hand. "What is your problem?", I ask. "Could you explain about the cube, sir?", he asks smilingly. "You mean about the cube or probability?", I ask for clarification. "Both sir," he nods. I explain his complex question (for that class) without any hesitation. "Can you find anything like this around your home?", I ask. "Yes sir, I can find some wooden blocks", He responds. I again remind him about 'the head and tail activity' and then generalise it in the case of the dotted cube.

The teacher communicates symbolically that I have only five minutes remaining for that class. Since I am about to finish my intended activities, I summarize my lesson and leave the room. I walk around the school premises for 10/15 minutes before going to the main office room. As I approach the office, the boy who raised plenty of questions in my class is coming out of the office. "Where are you from?", I ask him. He runs away without answering my question. As I enter the office, the teacher speaks to me in the language of apology, "Sorry sir, the boy is a bit erratic. He talks a lot but is very bad in the test."

It is worthwhile mentioning the usefulness of Cleo Cherryholmes' (1988) analogy of an 'odd imagination'; that a list of mute *content* can guide the dynamic process of teaching. Such an analogy seems appropriate for explaining the *odd reform* of classroom teaching and learning by employing only conventional curriculum metaphors (e.g., curriculum as subject matter, discrete tasks and concepts, planned activities, cultural reproduction, and so forth). Given the analogy of odd reform, I will explore some issues of curriculum reform on writing the commentary of the story, *Sorry Sir! The Boy Is Erratic*.

My story indicates a century-long notion of curriculum change as changing some subject matter irrespective of educative practices. I am not denying that new content can demand different teaching learning approaches from the conventional ones. For me, changes in curriculum can be conceptualised by identifying differences between

previous and subsequent teaching approaches, emphases, goals, educative structure, and subject matter. Differences are always possible in educative phenomena. A teacher's teaching approach changes from time-to-time: he/she can subscribe to new perspectives; his/her growth of ideas can improve his/her teaching; and significant changes (e.g., *marriage, having a baby, losing loved ones and so forth*) in one's life can bring many changes in her/his pedagogy. In essence, changes in curriculum are not a matter only of introducing new subject matter but also of bringing changes to the educative process.

Understanding the phenomenon of *curriculum change*, however, is elusive. Literally, to know about something is to produce a definition. For me, one of the many difficult tasks is to define a word as though its meaning is unchangeable. However, the alternative approach to literalism is to use metaphors to grasp the dynamism of meanings of the term. For instance, change as *alteration* indicates a revision or an amendment. Similarly, change as *metamorphosis* is more than an *alteration*. It represents multidimensional changes. Inculcating curriculum change as to introduce *new content*, as though it can transform the teaching-learning process automatically, is a clear indication of regarding curriculum change as one-way *stuffing*. In my experience, this type of change regards school as a conduit for transmitting such stuff to the students. Consequently, teachers are regarded as only a means of imparting someone's knowledge rather than what Taylor (1998) labels them to be, 'ends in themselves'.

In the story, my role as a demonstrating teacher was not very different from the traditional role of a teacher. My initiation was just a small effort within the conventional notion of teaching as sending the *stuff*, although my way was a little more meaningful. However, efforts to change classroom teaching can affect positively other aspects of the educative process. Perhaps, using subject matter creatively and contextualising it can bring many changes even within the traditional curriculum images.

Glen Aikenhead (2000), a science educator, advocates that reforming the culture of science is essential in order to make it inclusive of all students. He says that official

science represents a singular worldview. The conflict begins when school culture (school itself is a subculture of the community which it represents) and science culture does not match each other. This notion can be true also in the field of mathematics education as conflicts between the cultures of official mathematics and school subculture have been reconceptualized since the mid eighties (e.g., ethnomathematical perspective of D'Ambrosio, Bishop, cited in Nunes, Schliemann & Carraher, 1993). Conceptualisation of such conflicts may be difficult because of our massive enculturation into the culture of official mathematics. Such conflicts afflict our role as a teacher from time-to-time. For instance, some aspects of *expert authority*, such as authority over subject matter, concepts, and definitions, are transferred to the teachers. With these, teachers as local authority rule over the students. Indirectly, this cultural derivation can represent the culture of mathematics, which tries to prepare students to think only within the box of mathematics.

Jurgen Habermas's (cited in Taylor & Campbell-Williams, 1992) classification of interest can be an important referent for discussing this phenomenon. Whose interest is being served by our school mathematics curriculum? Has it helped students to become emancipated? Has it helped to understand the situation to facilitate their participation in the decision-making process? For me, it is very hard to answer these questions positively because each year's *School Leaving Certificate* examinations[42] labels only a one-third section of the students as successful students[43]. Perhaps, it is not premature to label our school mathematics as being guided by the technical interest of mathematics communities.

The *erratic student* character of the story symbolically represents the students who really want to know something more than just the subject matter. They may think out of the frame; they may be more imaginative than their teachers; and they can develop better understanding than the author of their textbook. However, the power of authorship (Cherryholmes, 1988) always tries to impound students' ideas into a trashcan. Improving this situation demands our efforts in cultural reconstruction of mathematics education. Perhaps, an egalitarian educative environment is essential to

[42] National level examination for secondary school graduates.
[43] The result is downloadable from www.doe.gov.np under *SLC result*.

reconstruct power hierarchies by making a justifiable co-participation of all agencies in the curriculum process.

Inclusive curriculum and language

'Non-graded students'

It could be any day in September 1999. I was observing a grade-one math lesson in Tara Primary School. The teacher, Radha, was teaching the topic of simple addition. She started her class by asking a simple question: "I have fifteen marbles and my mother gives me another twelve. How many marbles do I have altogether?"

The kids seem to be solving the problem. Radha moves from one bench to another to confirm that her students are doing well. In the meantime, my eyes are caught by a nearby kid who is drawing twelve and fifteen beads separately and counting them repeatedly. The small boy's struggle to finish the task can really depict an example of 'learning as individual construction'. He finishes the task and hands it to Radha for a big tick. "Why did you make plenty of beads? I told you to use direct rule. Anyway your answer is correct," she gives a correct tick for it. I don't know about the rule she is talking about. I am unsure whether the boy has understood the language of his *miss*.

Radha finishes checking the 'class work' and writes another problem. However, the problem involves only numbers and the symbol of addition. She tells her students, "You need to use the rule." I ask a nearby kid for her 'math book' to find out her rule. I turn some pages. However, I am unable to find any rule in the book except for horizontal and vertical methods of adding two numbers. Perhaps, she means the rule for calculating the answer of each problem mentally. However, her rule seems to be a subject of confusion for her students.

No one finishes her new-rule-based problem for ten/fifteen minutes. So she asks all the kids to pay attention to her demonstration.
"Can you read the first number?"
"Eighteen miss," all but five/six students, who are sitting behind the class, chant.
"The second one?"
"Eleven miss."

"What is this symbol for?"
"Addition, miss."
"First you have to start from right side. From which side?"
"Right side, miss."
"Which numbers are in the right side?"
"Eight and one/ one and one/…" Their answers are different.
"Which one is your right hand?"
She laughs with a red face that five students raise their hands correctly and the others either raised their left hands or both hands. The backbenchers are still idle.
She takes one of the students in front of the class and asks her to demonstrate her right hand. She performs accurately. She again asks all students to raise their right hand. Still more than five students seem to be confused.
Now she demonstrates her rule of addition. The rule is to follow the 'official way' of addition. However, I am not sure whether her students got that.
She is about to end her class by giving a homework exercise. In the meantime, two backbencher students start to quarrel about something. She approaches there and says something in a mix of Nepali and a local language. Then, the students become quiet and we leave the room.
Enthused, I ask Radha why the backbenchers have not done anything.
"They are non-graded sir. Until, they became able to speak in Nepali, they will stay in the back of the room and listen to, watch and interact with others."
"But they were not doing anything today?", I ask again.
"I thought that this class was not suitable for them," she opines.
"How old are the non-graded students?", I ask again.
"Four are below eight and one is eleven, " she replies.

'I laughed because my mother laughed' is generally applicable to the child who does not understand the reason that makes her mother laugh. Slowly, she learns about why her mother laughs. She gradually develops her perspective about the world she experiences. Her thinking, speaking, acting and other activities are shaped and facilitated by her cultural milieus in which the language she learns has a very important role to play. For me, there is an intertwined relationship between language, learning and thinking. For instance, I have to think in Nepali language and then to

translate (mentally) in English. My translation, sometimes, does not convey the same meaning as I intend to express.

The story, *Non-graded Students*, is constructed according to my experience of working in some of the primary schools of Dhulikhel Municipality. Specifically, the story is intended to depict a cross-lingual context with differences between the intended language of teaching and the students' native languages. Subtly, the vignette also raises the issue about the confronting relationship between ordinary and mathematical languages. Given this, I will explore the issue of cross-lingual mathematics learning contexts. Similarly, addressing the issue about differences between ordinary and mathematical languages, I will search for some pedagogical implications.

Stieg Mellin-Olsen (1987) mentions from the perspective of the *Sapir-Whorf (S-W) hypothesis* that differing interpretations of the same phenomenon are quite likely given the differing linguistic backgrounds of persons. For me, it is an interesting perspective that a person's *linguistic capital* plays a very important role in determining her/his worldview. Despite the ongoing debate between language hypotheses in the linguistic realm, I agree with the idea that language is a means of representing a person's worldview. The mathematics classroom depicted in the vignette may draw our attention to rethink our notions of the medium of teaching prioritised by our curriculum. Are we considering multiple linguistic and cultural worldviews in our curriculum? Are we making more inclusive mathematics curriculum to fulfil the notion of *mathematics for all*? Are we preparing teachers to teach in multilingual contexts?

It seems to me that unilingual classrooms are unlikely given the multiple dialects and languages[44]. In my experience, our curricula have been prepared for monolingual classrooms, and teachers have also been prepared for the same. Perhaps, we need to reflect upon the focus of our education; we need to re-examine discrepancies between the expert-written curricula and the local situations. My story depicts that

[44] For a list of languages of Nepal see: http://www.ethnologue.com/show_country.asp?name=Nepal

some students may not be in the mainstream of the school until they develop a functional ability in the Nepali language: When would they be able to develop that?

I am not interested in making a global statement for a solution to this problem. Although some people love to utter the term *globalisation* and suggest others join with them to be a global citizen, I am deeply concerned about my worldview rather than subscribing to someone else's worldview in the name of a global view. For me, we need to take account of local situations and make local curricula (cf. implemented curricula) effective. Perhaps, our teachers need to be trained to prepare multiple dictionaries of local languages. For me, being a teacher in a cross-lingual classroom is to be a local linguist. For instance, teachers can collect basic words of different languages spoken in the community.[45] Such a dictionary can consist of local meanings of basic mathematical words such as *addition*, *subtraction*, *multiplication*, *take away*, *equal to* and so forth. Switching codes between Nepali and local languages can help the students who speak languages other than Nepali to cope with the unique *grammar of schooling*. Furthermore, this situation can help promote interactions between different cultural and lingual milieus.

The vignette also indicates a conflict between ordinary and mathematical languages. Susan Pirie (1998) pinpoints some problems while stepping from ordinary to mathematical languages. Agreeing with her exploration that it is quite problematic to make sense of the reduced symbolisation (e.g., depicting by *minus* for both situations: *comparison* and *take away*), we can witness students' difficulty in Radha's 'new rule'. The impasse between the common language and the symbolized language can be fulfilled after a gradual transition from word problems to *number-only* problems. For me, the focus of the curriculum and textbooks needs to be on the verbalised mathematical language rather than to be 'heavily symbolised' in the early grades.

What is the purpose of mathematics teaching? Are we teaching for producing mathematicians? Or, are we teaching for mathematized citizenries? In my

[45] Based on a paper presented by Dr. Vidya Nath Koirala, Faculty of Education, Tribhuvan University, Nepal in a local seminar held in Kathmandu.

experience, we are yet to be clear about the purpose for which we are teaching mathematics. Because the priority of current mathematics learning is in algorithms, rules and formulas, we hardly make our school mathematics inclusive of the whole population. The curricula, which are guided by a *technical interest* and *academic demands*, are likely developed according to the needs of some national and international experts rather than the needs of our contemporary Nepali society.

Child-centred pedagogical landscapes are likely to surge when we allow the blossoming of multiple worldviews in a classroom. Consequently, the notion of *language-in-action* (Mellin-Olsen, 1987) can help promote discursive mathematics. Rather than imposing a single worldview-laden mathematics, perhaps we need to reconstruct our culture of mathematics as a plural, mediated, needs-based and pedagogically democratic. In essence, it would be better for teachers like Radha to imbue more problem-oriented mathematics rather than a primarily rule-oriented mathematics. Using local words to depict basic mathematical terms, Radha could bring the backbenchers into the mainstream of her classroom despite the national curriculum's silence on such a burning issue.

CHAPTER SIX

CONCLUDING MY RESEARCH LANDSCAPES: A SYNTHESIS VIEW

Opening the cover-embedded *A4* size monitor of my laptop, I click the on/off switch to start my final chapter of the report. The laptop starts to load my personal settings *as though* it knows everything about me. My untrained fingers—I never received a formal training for typing—seem to be ready to portray my big ideas on this very small window. However, the monitor remains blank. "Come on," I speak to the machine. My focused eyes witness the monitor starting to display some desktop icons as though a curtain is uncovered to reveal a show. With a similar on-and-off of my ideas, I am still unclear about the nature of the text to be woven in these frames. Do I need to claim that I have found *the* answer to my research question? How do I claim that I know something about improving my professional practice? How do I represent my journey of inquiry in this final chapter?

Given these crises and questions, selecting the subject of my writing is a difficult task. Even the first paragraph is always in the twilight of thinking: Competing ideas seek their place in this tiny window. An idea comes to the fore of my thinking: one of the safest subjects to start with is 'me'. However, an obvious question – *what would you write about yourself?* – seeks an answer. With this, I envisage the value of this chapter as reflecting upon my background as a researcher, writing about my understanding of the process of knowing, reflecting upon my research questions and sketching some pathways for future research.

My background as a researcher

Starting my own research career goes back to 1997 when I conducted a study based on a set of diagnostic tests on linear equations. My notion of research was the process of *hypothesis testing* as though I could test someone's *depth* of anger, emotions and feelings. I thought that I could represent my *diverse population* by a single number called *mean*. I pretended to be a controller of many uncontrollable variables for identifying students' performance in the test. Furthermore, I could not

see any direct use of manipulating statistical parameters to improve my day-to-day teaching. I witnessed many purposive uses of statistics in order to probe something. My interpretation of research was guided by the notion that *reality is out there* and research is simply a conduit for bringing it into the public domain. Gradually, this notion divided me as a teacher and a *would-be* researcher as though teaching and researching could never meet.

While working at Kathmandu University, my understanding of the usefulness of research for improving my practice remained elusive. Prescribing a list of conventional standpoints as the saviour of teacher and students dragged me into obvious contradictions between realities and representations of educational phenomena. Conversing with the university's graduate students gave me a fuzzy picture of research as the job of privileged persons rather than of schoolteachers. Once, graduate students commented critically about the new policy of a government-training institute which had decided to involve primary school teachers in research activities as a part of their training. The students' main concern was that the teachers might not be able to understand the standard procedure of research. At that time, that argument sounded reasonable because the *data collection* notion of research would not be easy for primary schoolteachers with very little academic experience.

In the middle of confusion, darkness and vagueness, my *stored* definition of research was to follow scientific steps of inquiry to probe something. The steps were clear, but the appropriateness of the steps was in doubt in my mind: The emerging nature of research would be a joke within that paradigm. In accordance with the notion of validity and reliability, our world had to be explained as an unchangeable plate: Not to mention, *Pangea* which was broken into different blocks: Our Himalaya is not stable!

Learning through the journey of Border Crossings

For me, it is worthwhile mentioning Henry Giroux's (1992) notion of border crossing which allows me to depict my journey of crossing the borders of different learning worlds. Given this, I imported my vague understanding of educational research when

I started my postgraduate studies at Curtin University of Technology. Knowing that my taken-for-granted beliefs about research were at-risk, I gradually started to explore alternative approaches.

At the beginning of 2002, studying the unit, *Learning in Science and Mathematics*, challenged my initial notion of learning as shaping behaviours. Novak (1998), Vygotsky (cited in Gergen, 1995), von Glasersfeld (1995) and many others' notions of *knowing as constructing* helped me to cross the behaviouristic-cognitive border. I was attracted by case study research because of its focus on particularity rather than on generality. It gave me a sense that knowing several cases would help reconceptualize my educational settings. In this way, I was gradually crossing the border from *knowledge-corresponds-to-reality-irrespective-of-the-knower*[46] to *knowledge-can-approximately-model-the-world*.[47] Opting for a case study project for my *postgraduate diploma*, I gradually moved to the world of Guba and Lincoln's (1989) *fourth generation evaluation* as I wrote a proposal aiming at evaluating a teacher education programme for the unit, *Evaluation Issues*. This time, I had to convince my tutor why Guba and Lincoln's approach to programme evaluation would be appropriate for my context. In the meantime, I explored many obvious differences between Guba and Lincoln's constructivist epistemologies and others' epistemological standpoints.

By the end of 2002, I was crossing the border from *critical realism* to *experiential realism*. The unit, *Curricula in Science and Mathematics*, which I studied during the second half of the year 2002, gave me new perspectives on knowing, learning and educating; in particular, autobiographic genre of writing, metaphorical thinking (Lakoff & Johnson, 1980) and reconceptualizing personal meanings of curriculum. The unit provided me with a space for thinking about my pedagogical issues within the *curriculum field*. More than that, I found the notion of *metaphorical images* to be very powerful for conceptualising multiple meanings of curriculum rather than using only a literally generated definition. A disparity emerged between my previous

[46] Naïve realism.
[47] Critical realism.

understanding of *currere* as a narrow meaning of curriculum and my *new* understanding of *currere* as a powerful notion of (re)conceptualising my curriculum.

I crossed many minor and major borders while conducting this research. In the beginning, it was a shift from *knowing as probing* to *knowing as storying and reflecting*. Even after subscribing to such an epistemological standpoint, I tried initially to use a traditional epistemic structure for my research. However, as I moved towards the process of writing the research proposal and preliminary chapters, I realised that the traditional *five-chapter* structure does not help promote the notion of *research as an emergent and evolving enterprise*. Rather than taking the storied basis of representation as granted, I gradually started to search for multiple genres of representation. My supervisor, Peter, was of the view that I could use multiple genres to re-address the issue of representation. In the middle of these ideas, my Chapter Two appeared as an integrated form of three different genres: *drama*, *letter writing* and *dialogue*. It was another border crossing. Again, the process of research created some confusion from time-to-time, especially while writing commentaries of stories, vignettes and poems. At that point, I realised that I needed to subscribe to multiple alternative ways of knowing. Specifically, when portraying composite stories and vignettes and writing commentaries on them, I embraced a multiplicity of ways of knowing, such as phronesis (e.g., practical knowing, using personal practical wisdom), deconstruction (e.g., representation of meaning through ironic critique), interpretation (e.g., constructing meaning), transformation (e.g., using a critical perspective for transforming self) and self-reconceptualisation (e.g., exploring pedagogical meaning from my own life world experience).

Along with my *experiential reality*, I have used a number of other referents in order to facilitate my inquiry. Specifically, I have used the term *referent* in order to allow 'me' to address my professional needs: Using a particular theory or a model as a framework may supersede 'me' in my research process. Specifically, I have used multiple forms of constructivism such as *radical* (von Glasersfeld, 1995), *critical* (Taylor, 1998) and *social* constructivism (Ernest, 1991). Subscribing to *radical* constructivism has helped me to portray my experiential reality in a *viable* representational form. I have used *critical* and *social* constructivism as referents for

advocating a quiet revolution for improving the culture of our educative milieus. Schubert's (1986) curriculum metaphors have guided me to construct and elaborate clear perspectives on various issues of curriculum and pedagogy. Crossing the border from definition-oriented knowing to metaphorical knowing, I have used various curriculum theories as minor referents. Needless to say, one of the many *borders* of my thinking was conventional mathematics. I was challenged many times by the traditional nature of mathematics which advocates the universal nature of knowing and educating. When I started to explore some possibilities for the cultural contextualisation of mathematics, I crossed the border from a Eurocentric mathematical perspective to an ethnomathematical perspective. For me, ethnomathematics is visible in many of my commentaries as one of my main *research referents*. In addition, I have raised a number of issues because of the prevailing lingual and cultural *incommensurability* between official and local mathematics. In doing so, I have used another referent, the Geometry-Theory Model, developed by Ken Kawasaki (2002). Upon using this model, I saw strong possibilities for using multiple worldviews to sensitise student thinking in order to improve the conventional pedagogy of mathematics.

With multiple horizons, I am about to complete this section. On the threshold of another border, a question is vigorously expecting my answer: What do you know from this research? Again, I try to convince the question(er) that I am no longer situated within the border that allows me to (re)produce a readymade answer. Perhaps, this (conventionally minded) question tries to listen for a conventional (e.g., point-wise, terse and scientific) answer rather than for the storied form of my answer. Suggesting the need to reformulate this question, I shall synthesise the images of my much detoured journey which led my ways of knowing towards a constructive exploration of multiple curriculum images.

My research questions

The notion of *fishing metaphor* (e.g., familiarizing, bringing together) is worthwhile mentioning here: the vital role of research questions in shaping and facilitating narrative research. In my experience, it is not only the questions or the researcher

that brings both together, but also the process which helps reconceptualize the connections between research questions and contemporary educational theories (Dagher, 1991). In my experience, my research is a continuous dialogue with my research questions and theoretical standpoints. In such a dialogue research questions are questioned and answered many times. However, they are not questions which are never changed or pretend to be unchanged: Instead they are continuously changed, accommodated and adapted.

My research questions have a history. They were developed at times when I was challenged by various perspectives; I was contested by different paradigms of knowing; I was transiting from weak forms of alternative knowing to stronger ones. Often, histories of research questions are forgotten (or not written) in conventional research: It is mythicised that such histories have a high degree of subjective representation. For me, *ubiquitous subjectivity* (von Glasersfeld, 1992) is not only associated with the formation of research questions but also with the interpretation of their answers: The subtlety of history is always implicated in any research no matter what epistemologies are being employed. Decay and growth of ideas are always embedded in the history of research questions. You may be curious about *the* beginning of my research questions. However, I have perceived many beginnings: the beginning of my educative life, the beginning of my unquestioning acceptance of knowledge, the beginning of my critical thinking and many other beginnings. Indeed, I was trying to squeeze my many beginnings into one. I was trying to merge many ideas into two/three research question. More than that, I was trying to find a *holy grail* for making a single question for an autoethnographic inquiry. In some instances, I was too frustrated by the field of this *cutting edge* research which hardly prescribes anything for the research community. The *context-based-ness* of exemplars rarely spoke to my specific research needs (Ellis & Bochner, 2000). Perhaps, because of the *meaning-is-out-there* metaphor rooted in my thinking, I was trying to find already prepared research questions for my self-study research.

The temporal and sequential aspects of my research questions' history are worthwhile portraying in this place. In my experience, the ritualistic tradition of using the *jigsaw* puzzle of research *problem*, *question*, *objectives hypothesis* and

result is rampant in our research space. I am not blaming others, rather I am reflecting upon my desperation in not being able to write a simple, linear and mono-variable research question. However, Peter did not express dissatisfaction towards my inability to formulate a definite research question; instead, he focused on my *research problem* which had to deal with cultural contextualisation of mathematics. Even so, during the ritual of proposal writing, my research questions seemed to be imperfect in relation to their coverage, focus and intention.

I read Connelly and Clandinin (2000) in order to make sense of criteria for narrative research questions. They mention that narrative research questions should possess the qualities of being represented in multiple dimensions: *what*, *how* and *why*. The reading gave me an assurance that I was not going in the wrong direction nor was I making the serious mistake of 'going nowhere' by subscribing to the history of research questions as fixed, *momentumless* and static. Indeed, such traditional research questions hardly allow researchers to be reflective and reflexive throughout the process of conducting their research: They are not represented by dimensional temporalities: past, present and future; they are rarely portrayed by multiple conceptual complexities; and they are rarely taken as a means of exploring important questions, but mostly as ends in themselves.

In the context of my research, the questions have been addressed from time-to-time. Rather than drawing a *one-sentence* conclusion for the research questions, I have regarded them as evolving *foci* of my research. Therefore, each chapter has constructed some answers to my questions. In constructing answers, I have raised plenty of other questions. Questioning, for me, is also the first step of answering questions and curiosities. For instance, depicting my experience in the *letter writing*, *theatrical* and *dialogic genres* (e.g., Chapter Two) gives a multiplicity of answers to the research questions.

Research question 1: To what extent do the school mathematics curricula of Nepal incorporate Nepali contexts within the subject matter?

As the *habitus* (Sullivan, 1990) of the traditional research enterprise requires us to come up with some answers or conclusions, I am trying to perform that ritual as well. However, this ritual cannot be regarded as universal and generic, instead it is specific. Such a specific ritual can be interpreted as answers. My first research question – *To what extent do the school mathematics curricula of Nepal incorporate Nepali contexts within the subject matter?* – takes me to revisit my representational landscapes of different genres. Specifically, my Chapter One, *My School Days: A Canvas of Foreign Mathematics*, indicates many discrepancies between the local context and the subject matter of school mathematics. Weaving my experiential text into three difference genres, Chapter Two, *Making Meaning out of Meaningless Mathematics*, presents a picture of teacher preparation courses. Perhaps, you may not see the direct relationship between my first research question and that chapter. However, this chapter portrays a relational context between a teacher education program and its impact on school curriculum. Seemingly anomalies between the local context and content are apparent in Chapter Three, *Teaching (Others') Mathematics: My Experience of Time, Text and Teaching*, which portrays my experience of teaching *foreign mathematics* to Nepali students. Although the *experiential field* of Chapter Four, *Enculturation, Power and Mathematics*, is university, it enables new research questions to emerge related to alternative epistemologies of mathematics education. Perhaps, the contextualisation of teacher education content is central to this chapter as well as the epistemological ground of the pedagogy according to which I was trained. The stories of Chapter Five, *Multiple Images of School Mathematics Curricula: Experiences of a Teacher Educator*, provides some new perspectives related to my experience of multiple meanings of school mathematics curriculum. Perhaps, this chapter helps excavate a range of confrontations between locally enacted and centrally implemented curricula. At this stage, I have to particularise that very few teachers with whom I have worked have contextualised curriculum effectively: They have embedded local contexts in the subject matter. For me, this can be explained as pedagogical *perestroika*[48] (Goldberg, 1988) within our traditional curriculum edifice.

[48] Restructuring some aspects of a system without any major change.

Some of you may argue that it is not possible to use local contexts to frame the subject matter. Because of our misconception that mathematics is a culture-free subject, we tend to depict it as independent of local contexts, personal perspectives and cultural worldviews. However, describing mathematics as a culture-, perspective-, value-, and ideology-free body of knowledge puts us in a position that we as mathematics community members have nothing to say about the human endeavour to construct this 'nearly structured mathematics'. Sticking to such an archaic idea, we may never be able to justify the need for mathematics in a broader social perspective. Perhaps, this discussion leads me to raise a couple of questions: What is the nature of mathematics? What are prevailing conceptions about mathematics among the Nepali mathematicians and mathematics educators?

Research Question 2: To what extent do the Nepali mathematics teachers embed Nepali contexts in their teaching practices?

My second research question – *To what extent do the Nepali mathematics teachers embed Nepali contexts in their teaching practices?* – is not substantially different from the first one. The vignettes of Chapter One, *I Have No Language, Definition of Triangle* and *We Have the Power*, the drama and dialogue of Chapter Two, *Hyperbolic Geometry in Nepali Theatre* and *Long or Short Lesson Plans?*, give some direct or indirect answers to this question. However, I cannot give a percentage of the extent to which Nepali teachers embed Nepali contexts in their teaching practices. Fairly speaking, teachers like Sita, a teacher character in *Storying Variable and Constant*, are making creative use of the existing non-dynamic curriculum texts. Teachers like Mr. Scorn, a character in my autobiographic vignette, *We Have the Power*, Dr. Acharya, a character in the vignette, *Generating Moments*, and Dr. Euclid, the teacher character of the drama, *Hyperbolic Geometry in Nepali Theatre*, seem to be holding the view that the sole purpose of mathematics teaching is to transmit knowledge from the textbook to the blackboard and then to the minds of the students.

Looking back, I can see that my role as a teacher (e.g., Chapter Three) for enacting *foreign textbooks* was quite challenging. Perhaps, my role was not much different

from Mr. Scorn and other traditional teacher characters of my stories. However, trying to incorporate local contexts put me in a dilemma because of my limited understanding of mathematics, education and teaching. Does Chapter Four speak about the incorporation of local contexts in day-to-day teaching and learning activities? Indeed, I can see the issue has been discussed from two perspectives: first, the chapter has depicted my experience of the teacher as a (passive) conduit for sending static text from textbook/notebook to students and, second, possibilities of using alternative epistemologies for making consensual meaning of abstract mathematical concepts (e.g, *sequence, boundedness*, *convergence* and *divergence*). As part of my experiential tales, Chapter Five portrays a range of obstacles to incorporating local contexts in teaching practice. However, this chapter also sees some possibilities for enacting mathematics curriculum according to local contexts.

Upon arriving at this stage of my journey, the issue of cultural contextualisation of mathematics teaching has become more relevant to my professional practice than I perceived at the beginning of my research. Embedding my experience with recent perspectives on ethnomathematics helps me to search for more questions as well answers from my own professional context. Are we designing mathematics curricula justifiably? Are we teaching mathematics to liberate our students' thinking or are we teaching mathematics to cage them within a narrow perspective? Are we teaching mathematics for the sake of mathematics or are we teaching mathematics according to the needs of our society? Are we reproducing the conventional culture of mathematics or are we implying the notion of cultural reconstruction of mathematics?

In the context of my professional practice, the first two research questions demonstrate my concern for the improvement of my personal pedagogy, as I am also a member of the mathematics education community. Rather than making polemical comments from standpoints at the extremities of the questions (i.e., conventional versus progressive), pragmatic solutions to the problem are always expected. In

exploring such solution, I need to bring in the notion of dialectical thinking[49] (Willison & Taylor, in press) and an *integral perspective*[50] (Settelmaier & Taylor, 2001) which can explore a multitude of avenues of searching for answers to my questions. For me, dialectical thinking and an integral perspective give a space for thinking along the continuum rather than sticking to either of the extremities. In my experience, we have been embracing dualistic thinking[51] by focusing on so-called *non-contaminated* mathematics for our school curricula. The prevailing notion of non-contaminated mathematics has been promoting the century-old *content transmission model*. Instead of subscribing to mathematics teaching as a one-way-street, it is essential to uncover the ubiquitous alternative metaphors of teaching and learning: and to consider their relationship with various curriculum metaphors.

Research Question 3: What does the image of mathematics curricula look like, in accordance with various curriculum metaphors?

My third research question – *What does the image of mathematics curricula look like, in accordance with various curriculum metaphors?* – seems to be demanding my *recapitulative* standpoint(s) on mathematics curricula according to which I studied and taught. Taking my *experiential warrant* and Schubert's (1986) curriculum metaphors as main referents, I have constructed a qualitative map of my experience of the actual mathematics curricula of Nepal (Figure 6) by combining various curriculum images which I have explored throughout this inquiry. For instance, the stories and vignettes of Chapter One embed the image of mathematics curriculum as *static text* (i.e., with very few degrees of local enactment), whereas Chapter Two encapsulates my experience of multiple curriculum images: *subject matter*, *cultural reproduction*, *planned activities*, and *author's text* (i.e., regarding expert prepared chapters and exercises as curricula themselves). Even the theatrical representation of my experience of learning hyperbolic geometry embeds the image

[49] *Dialectical thinking*, according to Hegel, is to honour the veracity of co-existing irreconcilable opposites (i.e., thesis and antithesis) to construct an integral/holistic perspective of an issue/phenomenon.
[50] An integral perspective, proposed by Ken Wilber, combines the subjective and objective frames of knowing into an integral framework.
[51] Thinking based on *digital/excluded middle* logic.

of mathematics curriculum as *discrete tasks and concepts* as Dr. Euclid (the teacher character) focuses more on definitions, facts and (meaningless) theorems.

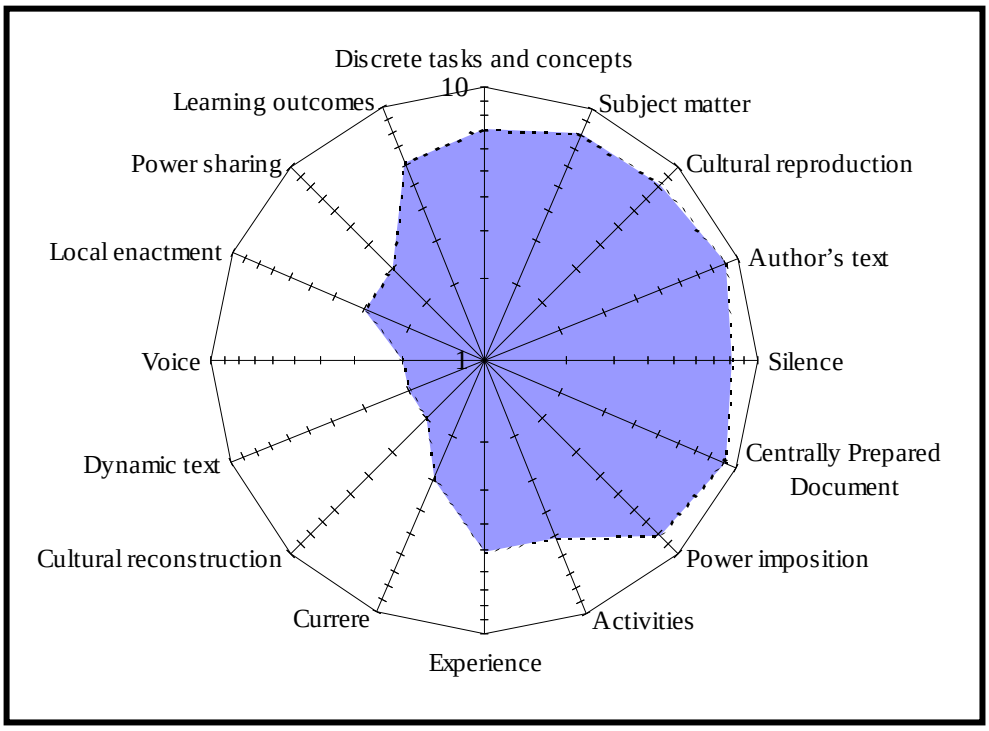


Figure 6: My actual qualitative map of school mathematics curricula of Nepal

Revisiting my Chapter Three gives the prevailing image of mathematics curriculum as (*foreign) subject (matter)*. More than that, it depicts the image of curriculum as *author's text*, *silence*, *voice* (to some extent), *subject matter*, *local enactment*, *cultural reproduction* (i.e., preparing students as instrumental communicators of mathematics rather than helping them to be critical thinkers), and so forth. Depicting multifaceted notions of time, this narrative-embedded chapter explores a set of conventional curriculum images of the time when I was using a series of foreign textbooks as a teacher in a Nepali school. Chapter Four depicts the curriculum images of my first masters' course as comprising the *author's text* with a low degree of *local enactment*. Furthermore, the vignette, *Three Mathematical Contexts*, represents a prevailing attitude against opening creative possibilities within the mathematics education community. For me, this vignette also reflects a conventionally *imposed* mathematics curriculum rather than a *culturally constructed* and *shared* one.

Writing this account helps me to be cautious about the complex nature of the *once-named-as-moribund* curriculum field. Indeed, the landscapes of curriculum are as complex as a terraced topography. My Chapter Five has encompassed a multitude of examples of curriculum images. Specifically, the vignette, *Bell, Parallel and Perpendicular Lines*, portrays my experience of observing a class with the image of curriculum as *subject matter, discrete tasks and concepts* and *a document*. In saying so, I am not arguing that this vignette exemplifies only a single curriculum image; instead, I am taking one of many images that can be constructed from my composite story. Perhaps, we can construct a range of curriculum images from the next story, *The Death of Silence*. For instance, curriculum as *silence* and *voice, power imposition,* and *sharing* are embedded in the interaction between 'characterized me' and the teacher character. *Curriculum as local cultural enactment* can be the central curriculum image in *Storying Variable and Constant*, which also is indicative of some possibilities for localising curriculum as *dynamic text* (i.e., exploring contextual meaning of mathematical concepts) and even *currere*—a process of personal reconceptualisation of teaching and learning—for the teachers and students. Portraying the expert's curriculum image as a *centrally prepared document* (i.e., curriculum prepared by the Curriculum Development Centre), the vignette, *They Don't Have Any Ideas About Curriculum,* depicts some prevailing adversarial understanding of curriculum between schoolteachers and 'experts'. Regarding the curriculum as only 'the business of the experts' has purposely nurtured the images of curriculum as *power imposition, author's text, centrally prepared document* and so forth. Similar curriculum mages can emerge from the lesson of Radha, a teacher character of the story, *Non-graded Students*.

My actual image of mathematics curricula (Figure 6), in which I studied and taught, draws on my whole inquiry as a synthesised view of Nepali school mathematics curricula and mathematics curricula of Nepali teacher education programs. In writing vignettes and commentaries, I have also depicted my perspectives on *alternative curriculum images* that can help promote the cultural contextualisation of mathematics teaching-learning activities. Synthesising my alternative views, I have drawn a preferred qualitative map of mathematics curricula for Nepali teacher

education programs as well as schools. Comparing my experientially constructed actual curriculum image (Figure 6) with my preferred image (Figure 7) illustrates visible differences between a conventional (i.e., neo-colonial, fragmented, subject-based) curriculum perspective and a reform-oriented inclusive curriculum perspective. Whereas the pictorial representation of my actual image covers substantially the traditional territory (i.e., the right half of the graph), the representation of my preferred image covers either side of the territory in a more balanced manner. Does not this indicate that we need an *integral view*—incorporating multiple and often contrary perspectives/frameworks—on designing and implementing curriculum?

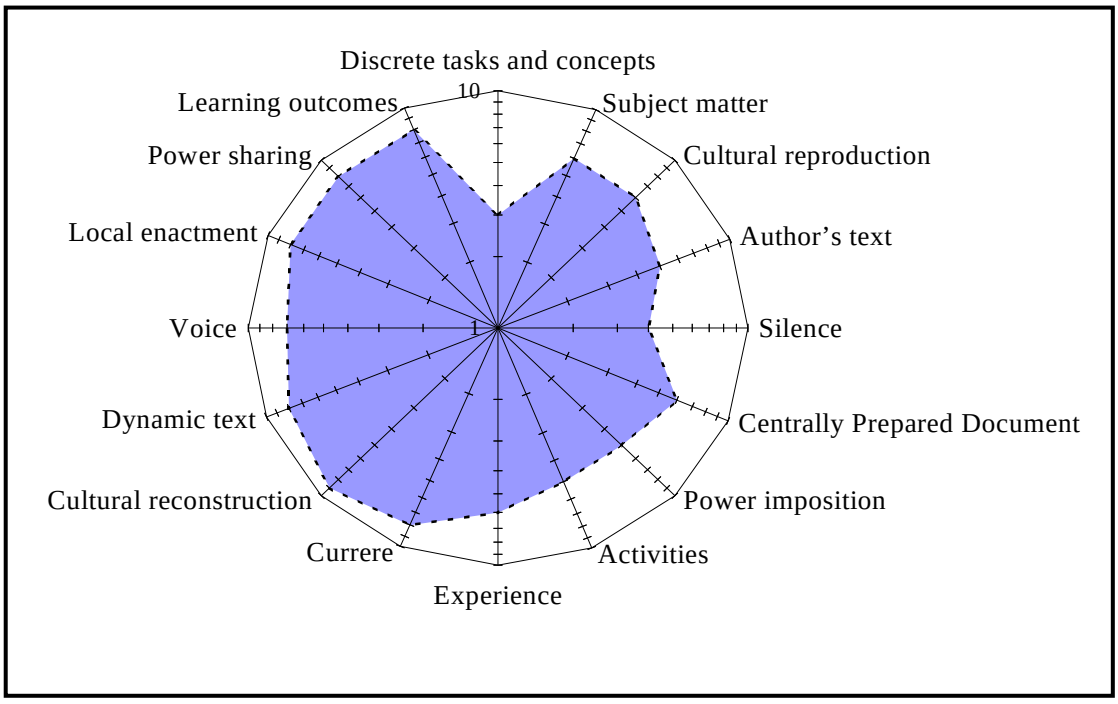


Figure 7: My preferred qualitative map of mathematics curricula of Nepal

Some future possibilities

Although I am almost at the endpoint of this report, I envisage that this is a beginning of many possibilities that have been built on the present inquiry. Perhaps, it would be wise to say that arriving at this *station* is a moment for planning to explore multiple avenues of my further research rather than for completing the ritual of making universal recommendations. Searching for future possibilities gives me three distinct

fields of inquiries – *curriculum field*, *philosophy of mathematics education* and *ethnomathematics* – for continuing my journey.

Curriculum field. This inquiry has given me some enveloping perspectives on establishing strong relationships between teaching, learning, personal life and other educative processes. I have developed a view that such complex educative areas can be discussed smoothly within the field of curriculum which, for me, seems to be a *borderless* field. Given this, my future research can focus on the issues of constructing culturally viable mathematics curriculum images for Nepali schools. Using multiple genres for data representation and multiple approaches to data collection/generation (e.g., teacher stories, interviews, field notes, class observations, student journals and document analysis), I may expand my present metaphor of research to research as *exploring in a terraced land*.

***Philosophies of mathematics education*.** My project reflects that I am passionately interested in exploring multiple reform-oriented philosophies of mathematics education. Specifically, my focus is on multiple constructivist philosophies with a view to improving my practice as well as the pedagogical milieus of Nepali mathematics. Furthermore, I will focus on the longstanding relationships and differences between the ontology of a mathematical worldview and Nepali (cultural) worldviews. Choosing this area as my future research, I will use multiple methodologies and genres for data collection/generation and representation.

***Ethnomathematics*.** Placing the subsection of ethnomathematics in third place does not mean that I shall put less emphasis on it; instead, it will be embedded in both of the proposed fields of study, if it is not taken as the sole area of my future research. Taking ethnomathematics as a main field, my focus will be on searching for the nature of local mathematics. Specifically, focusing on traditional cultural tools, such as myths, folklore, and artefacts, as the main subject of the study, I will explore the nature of multiple 'mathematics' embedded in our multiple cultural milieus. For this, my methodological schemas will include interviews, field-notes, observation of cultural rituals and analysis of cultural documents.

Epilogue

By now you should have constructed a set of images about my research and myself. I assume that you delved into your own meaning instead of being absorbed by my texts. It seems quite funny that as a writer—I do not want to be *the* author—and a researcher, I am encouraging you to make your own meaning out of my text. However, I cannot claim that there is no trace of authorship. Instead of employing a dualistic claim, I have learnt to be dialectic and inclusive. Perhaps, this may be one of the consensual conventions for reading my writing. At this moment, I would like to thank you for taking your time to wander around my report. As my space seems to be limited I conclude my research (for now) with the following stanza from my diary:

Writers,
write for many
not for some
write for creation
not for destruction
write from your conscience-attached pen
not from a motionless biro
write to farewell noxious and belated nights
write to welcome precious beautiful mornings
write with a vigour of constructive transformation of human life
(17, October 2003)

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INDEX

academic demand, 113
aesthetic, 6, 8
agency, 91, 103
algorithm, 30, 64, 66
anthropomorphic, 44
authoritarian regime, 83
authority, 24, 27, 28, 35, 49, 82, 84, 89, 102, 103, 108
authorship, 46, 49, 84, 108, 129
autobiographical representation, 4
autoethnography, 5
belief systems, 84
bipolar, 79
border crossing, 115, 117
boundedness, 123
calculus, 44, 47, 48, 49
cardinality, 77
Cauchy criterion, 76
cold reason, 34, 81
collective self, 92
composite character, 7, 10
conduit, 34, 44, 71, 107, 115, 123
connected knowing, 78, 79
consensual dimension, 80
constructivism, 3, 6, 79, 117
constructual contrivance, 64
contextualisation, 5, 43, 46, 48, 81, 118, 120, 121, 123, 126
co-teaching, 92
craftsmanship, 56
cross-lingual classroom, 112
crystallisation, 4
cultural enactment, 95, 98, 126
cultural reconstruction, 108, 123
culture, 5, 29, 35, 43, 47, 49, 61, 74, 84, 97, 103, 107, 113, 118, 122, 123
currere, 101, 104, 117, 126
curriculum as a document, 97
curriculum as discrete tasks and concepts, 125, 127
curriculum as dynamic text, 98, 126, 129
curriculum as experience, 101, 104
curriculum as learning outcomes, 127
curriculum as Other's text, 93, 94
curriculum as power imposition, 126
curriculum as subject matter, 106, 126
curriculum change, 3, 91, 106, 107
curriculum images, 101, 103, 107, 118, 124, 125, 126, 128
deconstruction, 6, 117
desire to control, 73, 74
dialectical, 124
dialogic, 10, 30, 55, 89, 94, 120
drama, 15, 37, 38, 39, 40, 41, 117, 122
dramatic control, 7
dualistic thinking, 124
empathetic understanding, 79
enculturation, 73, 108
epistemology, ii, 6, 48
ethnomathematics, 2, 79, 84, 118, 123, 128

experiential reality, 6, 48, 65, 117
experiential warrant, 5, 124
fictional writing, 4
folklore, 97, 99, 128
foreign mathematics, v, 10, 12, 13, 14, 64, 66, 121
grammar of schooling, 112
habitus, 121
happy-ending stories, 99
hard control, 34, 75
hidden treasure, 102
ideological propagation, 84
infallible, 73
integral perspective, 35, 124
interests, 29, 36, 84
interpretation, ii, 46, 47, 48, 65, 76, 115, 117, 119
journey, 1, 2, 3, 4, 5, 6, 7, 9, 10, 11, 13, 23, 97, 114, 115, 118, 123, 128
knowledge claim, 6
learning experiences, 44, 103
legitimacy, 6, 8
linguistic capital, 111
literal, 21, 76
local curricula, 112
local mathematics, 84, 118, 128
metamorphosis, 107
metaphorical, 98, 116, 118
metaphorical images, 98, 116
metaphorical knowing, 118
metaphors, 9, 22, 56, 65, 98, 106, 107, 118, 124
midpoint theorem, 57
moribund, 126
multiple dialects, 111
myths, 9, 34, 58, 97, 128
narrative, iv, 5, 8, 13, 118, 120, 125
Nepali Shanai, 37, 39, 43
Nirvana, 9
non-Euclidean, 4, 42, 43
official mathematics, 17, 84, 108
one-way-street, 81, 124
ontological standpoints, 84
ontology, 6, 30, 128
ownership, 74, 84, 91, 92, 93, 103
Pascal Triangle, 84
pedagogic being, 103
pedagogical praxes, 92
pedagogical thoughtfulness, 5, 10
pedagogical wakefulness, 6
perestroika, 121
personal pedagogy, 92, 123
personal practical knowledge, 5, 54
personal reconceptualisation, 6, 126
personal self, 93
phronesis, 6, 117
plot, 4, 13, 82, 87, 98
poem, 27, 59, 65, 66, 83, 87
poesies, 6
poetic representation, 10, 83
political text, 93
polyvocality, 95
postmodern-constructivism, 1, 4, 6
postmodernism, 4
power, 10, 31, 33, 34, 35, 36, 49, 64, 70, 82, 83, 84, 89, 93, 104, 108, 126

power sharing, 36
practical knowing, 6, 117
pragmatic, 81, 123
public educator, 74
realism, 116
reduced symbolisation, 112
referent, 5, 8, 88, 108, 117, 124
representation, 1, 4, 6, 7, 8, 10, 21, 30, 47, 54, 65, 71, 81, 82, 83, 84, 117, 119, 124, 127, 128, 131
rituals, 55, 83, 97, 128
rubber sheet geometry, 19
Self and Other, 58, 59, 82, 92, 93
semantics, 81
sequence, 28, 47, 75, 76, 79, 100, 105, 123
silence, 29, 30, 92, 113, 125, 126
situatedness, 5, 44, 73, 89
social constructivism, 117
socially mediated, 78
static text, 123, 124
storying, 117
subjectivity, 119
syntax, 81
technical interest, 108, 113
technical rationality, 74
textuality, 7
theatrical, 10, 120, 124
transformative pedagogy, 30, 75, 94
trilateral, 19, 20, 42
triple crises, 6
typestrokes, 83
validity, 115
verisimilitude, 7
viability, 43, 56, 73, 78
voice, 12, 32, 34, 35, 70, 83, 86, 90, 92, 93, 94, 98, 125, 126
ways of knowing, 6, 9, 117, 118
wisdom of practice, 92, 104
worldviews, 5, 43, 48, 49, 93, 111, 113, 118, 122, 128
writing as inquiry, 4, 8