Original Research Article

Exploring My Images of Mathematics and Its Influence on Learning

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Abstract

The major aim of this paper is to explore my images of mathematics and its influences on my teaching-learning strategies. I have employed an auto/ethnographic research design to excavate my lived experiences largely informed by interpretive and critical paradigms. To generate field texts dialectical and historical-hermeneutic approaches have been used. The Habermas' knowledge constitutive interest and Mezorows' transformative learning theory were used as theoretical referents. The writing as a process of inquiry has been used to create layered texts through thick descriptions of the contexts, critical self-reflexivity, transparent and believable writing aiming to ensure the quality standards of the research. The research illuminates that most of the negative images of mathematics have been emerged by the conventional transmissionist 'one-size-fits-all' pedagogical approach. Likewise, it has indicated that to transform mathematics education practices towards more empowering, authentic, and inclusive ones, it must be necessary to shift in paradigms of teaching and practitioners' convictions, beliefs, values, and perspectives as well.

Keywords: *Image of Mathematics, Mysterious Mathematics, Unconventional Mathematics, Nature of Mathematics, Pedagogical Approach, Perspectival Changes*.

Setting the Scene

This research paper is based on my M.Phil. dissertation. In my M.Phil. dissertation, I had tried to explore my images of mathematics, curriculum, pedagogy and assessment aiming for envisioning an alternative mathematics education in the context of Nepal. In doing so, I had formulated four research questions related to nature of mathematics, mathematics curriculum, pedagogical and assessment practices of mathematics education. Now, in this paper, I have devoted my attention in the first research question, which has been related to my images of mathematics and its influence on learning.

Mathematics is one of the major subjects in which I have been engaging as a student, teacher, teacher educator, and practitioner-researcher for three and a half decades. I have devoted most of the time to perform mathematical algorithm for solving bookish problems without questioning its foundational assumptions, socio-cultural values, and relationship with other subjects. I have simply performed the mathematical operations and robotically proved the mathematical theorems.

Nowadays, I do not imagine which forces/factors impulse my childish mind to embrace mathematics as my future career subject. At that time, I thought that mathematics was a universal subject. What I read here could be the same for all over the world. Its consistent characteristic under certain assumptions helps to describe physical objects or the world most accurately and precisely. It supports to recognize mathematics as one of the significant disciplines in school and university education boost somehow positive images of mathematics among practitioners (Goodwin, Bowman, Wease, Keys, Fullwood & Mowery, 2014).

Contrasting this view, many scholars explored the negative images of mathematics held by practitioners that had been rooted in teaching/learning activities, existing curriculum, individuals' perspectives, values (Sam, 1999; Ernest, 2008), prior achievement in mathematics, interaction with the peer group, and mathematical community (Lane, Stynes & O'Donghue, 2014). Different worldviews, values, socio-cultural perspectives, and practitioners' engagement in mathematical activities within and outside the school continuously prepares the ground for germinating positive/negative images of mathematics that implicitly and explicitly reflect on their teaching/learning activities. It indicates that different philosophical perspectives, knowledge-building processes, and eagerness of transforming their inner perspectives for creating an alternative discourse and practice might play a vital role in germinating diverse images of mathematics. In this context,

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I am willing to engage to uncover my wider range of images of mathematics that have been germinated during my academic and professional journey and connecting these images to mathematics learning.

Research Methodology

Research is an activity that focuses on constructing new knowledge. How to construct new knowledge? What is the role of the researcher? Whose values or interests are being served during the research process? These are some of the questions to address to contrive research joinery. That is, the researchers' worldview or perspective affects the research process (Wills, 2007). I believe that there is no single mathematical reality, which remains somewhere in a universe in the objective form. Mathematical reality is constructed by socio-cultural activities, interaction among mathematical communities and practitioners. As being an evolving discipline, its nature always remains corrigible and never bounds within the certain cultural milieu. In this context, I have tried to explore multiple realities via the inter-subjective knowledge construction process. During the process of the exploration, I have acknowledged multiple values, voices, and perspectives. To explore the multifaceted nature of mathematics and its influence on mathematics learning, a rigid and hypothetico-deductive approach may not be sufficient. I have realized that I have to employ emerging and flexible research method that enables me to become a critical self-reflector of my lived experiences and voices along with the others' experiences. In doing so, I have decided to use an auto/ethnographic research design in this inquiry.

An auto/ethnographic research focuses on exploring an individual understanding, practices, and engagement along with other practitioners' experiences for enriching a prodding process (Ellis, & Bochner, 2000). It is a method of revealing the researcher's lived experiences, which are embedded by socio-cultural, historical, and contextual practices. Mathematics teaching-learning activity is not a purely individual and isolated entity. It is largely a social, cultural, historical, and political discipline. To understand and grasp the true essences of such multifaceted mathematical activities being practiced in our context, the auto/ethnographic method is one of the suitable methods because it provides ways of exploring my experiences within the culture and excavating mathematics culture within me. Likewise, it has enabled me to ventilate my untold experiences, convictions, beliefs, and practices and simultaneously unmasks social, institutional, political, historical, cultural roles, activities, and discourses (Adams, Jones & Ellis, 2015) through critical reflective practices to make meanings and holistic understanding of the phenomenon.

The open-ended and transparent nature of the auto/ethnographic research helps me to generate my lived experiences, voices and embodied texts via my narratives, dialogue, and discussion with mathematical communities, authorities, and peer groups. In doing so, I have used dialectical and hermeneutical approaches together with writing as a process of inquiry (Richardson & St. Pierre, 2017) to make my wiring more viable and lively. The emergent writing process enables me to bring a thick description of contexts and practices together with my lived experiences and narratives through critical reflective writing, which supports to generate multi-layered texts eventually enriching the quality of my research.

To ensure the quality standards of my research, I have acknowledged the criteria of trustworthiness (Taylor, 2014) and critical reflexivity (Denzin 2017). The criteria of trustworthiness have been addressed through the process of transparent writing, bringing thick description of the contexts, being flexible and open to incorporate the emergent and evolving data texts in the writing (Taylor, Taylor & Luitel, 012). Likewise, the criteria of critical reflexivity have been ensured by engaging in spiral ways of critical self-reflective practices, questioning all forms of grand narratives and practices, and acknowledging changes (Richardson, & St. Pierre, 2017). Throughout the inquiry and the writing process, I was highly conscious to bring believable and lifelike experiences and narratives aiming for appealing readers to engross in my writing that encourages them to engage in critical self-reflective practices that might open a new avenue of transformative mathematics education practices.

Finally, I was highly conscious of being possibly self-indulgent and narcissistic during the exploration and meaning making process of the data texts that might confine my writing within a personal frame of references (Sparkes, 2000). Such practice could not contribute to shifting the conventional mathematics education practice towards transformative ones. Moreover, I have acknowledged personal, social, institutional, and academic values, norms and never disclosed personal and institutional identities (Udo-Akang, 2013) that helped me to maintain the ethical issues.

Theoretical Referents

The major aim of this research was to explore a connection between the images of mathematics and its teaching-learning activities of mathematics. For the interpretation and meaning making process, I had taken Habermas' knowledge consecutive interest (1972) and transformative learning theory (Mezirow, 1994) as theoretical referents. These two theories had supported me in prodding my lived experiences. The first one helped me to ponder on how I had come to formulate certain images of mathematics and to relate its influences on my learning. Likewise, the second theory provided the lenses for questioning on mathematics teaching-learning activities and how I could envision an alternative perspective of mathematics education that have empowered the practitioners so that they can be ready to engage in mathematical activities by embracing the broad aims of becoming a change agent via transformative mathematics education.

Knowledge Constitutive Interests

Habermas' knowledge constitutive interests describe the knowledge re/construction process within the certain interests: - technical, practical and emancipatory (Habermas, 1972). The technical interest is the interest of control, manage and exploitation for the fulfillment of personal greed and benefit. The mathematical knowledge is regarded as the external entity (object) uncontaminated by socio-cultural and indigenous practices. The major goal of teaching is to disseminate the holy knowledge to learners without due consideration of the socio-cultural, historical, economic and lingual backgrounds of the learners (Grundy, 1987). Autocratic, hierarchical, and bureaucratic pedagogical approaches are valued by the technical interest for conducting the mathematics teaching-learning activities in which learners are regarded as passive receivers of knowledge. Acknowledging social reproduction, maintaining the 'status quo', and establishing the cultural hegemonic practices as social norms and values are some of the hidden goals of technical interest, which embraces most of the teaching learning activities in mathematics education practices of Nepal result in evolving disempowering images of mathematics.

The basic orientation of the practical interest is to understand and sense making. The knowledge is regarded to be generated through the historical-hermeneutic (Habermas, 1972) process by deploying different methodological perspectives. So, knowledge is intersubjectively constructed through the social interaction process and its validity is not constituted in the form of references of technical control. According to this view, only external observations, hypothetico-deductive and empirical-analytic approaches cannot grasp the meaning of the mathematical reality. So social interaction and negotiation have a vital role to generate consensual meaning and understanding of the environment that ultimately leads to new form of knowledge (Grundy, 1987). Here, understanding means is not simply to grasp or absorb rules and law like procedures of a certain phenomenon that may be used to manipulate and manage the environment. Rather it is an interest in understanding the environment so that one can interact with it. Social contexts, interactions, consensual interpretation, personal judgment, and reflection are the major components for developing new knowledge.

The technical and practical interests limit the autonomy and responsibility of learners within a control and consensual meaning-making process. In contrast, emancipatory interest is concerned with the empowerment of learners. Empowerment is nothing but the ability of individuals and groups to work independently free from almost all type of external constraints and take control of their lives in autonomous and responsible ways.

Autonomy and responsibility are two major constituent components of emancipatory interest (Habermas, 1972). They interplay dialectically within an environment. I think if we believe in autonomous practices without any responsibility, it may turn into whimsical emancipation. Whereas, if we only believe in responsibility without any sort of autonomy it might turn autocratic practices that creates different type of oppressions.

According to Habermas (1972), emancipation meant to liberate from dogmatic dependence. Dogmatic dependence leads us to false consciousness. With the help of hypothetical-analytic logic, people who are in power use modern sciences and technology as neutral descriptors of the phenomenon to form so-called consensual knowledge that provides a firm foundation for developing hegemonic culture (Grundy, 1987) in educational institutions and society which help to inhibit the emancipatory interest in paly. It conveys that mathematics teaching-learning activities would not be restricted within the narrow framework of transmitting the mathematics knowledge from teachers to students' minds. Its major goals are to prepare conscious citizens so that they can read and write the world through mathematics (Gutstein, 2006) aiming for creating the better world.

Transformative Learning Theory

I have used the *transformative learning theory* (Mezirow, 1991) as another theoretical referent in my research. I have understood that transformative learning theory deals with how learners make meaning through their lifeworlds and come across the perspectival change in their lives. I have chosen the transformative learning theory as a referent because it paves a path for critical self-reflection on my experiences and supports me to articulate how I shift my taken for granted assumptions regarding mathematics education practices.

The central tenet of transformative learning theory is to enhance learners' understanding of how critical reflection plays a central role in learning and researching the educational phenomena. How researcher thinks and acts within a larger socio-cultural and political milieu are significant, rather than acting on the concepts, values, and feeling of others (Mezirow, 1997). It signifies that transformative learning theory focuses on how we make meaning of our experiences by shifting our conventional deep-rooted perceptions, values, and feelings. I have realised that transformative learning is nothing but an experience of a prevailing shift in our thinking, beliefs, and ways of meaning making of our lifeworlds; as a result, it provides a new lens of seeing, new ways of doing, and new ways of thinking about self, others and the world. Moreover, transformative learning is a learning process that helps to transform the problematic frame of references- a set of taken for granted assumptions and expectations (Mezirow, 2003).

I always try to improve my teaching/learning activities in mathematics being a researcher as a transformative learner. For this, I have acknowledged the four processes of learning discuss by Mezirow (1997). Firstly, I described the existing mathematics practices in our context that allowed me to reflect on my preliminary assumptions, values, and actions. Secondly, it advised me to establish new plots/spaces to reflect critically on my preliminary assumptions for envisioning an alternative vision for the betterment of mathematics education. Third I have followed ways of offering transformative learning by amending my beliefs and actions for better pedagogical practices. Finally, the fourth way of learning is to engage in transforming my deep-rooted habit of mind that inspired me for adopting new ways of thinking and acting by challenging all sorts of disempowering forces for the betterment of mathematics education.

Evolving of my Images of Mathematics and its Accompanies Practices

My formal educational journey commenced in the early 1980s at a rural primary school of Nepal located in the North-East part of the Kaski district, three to four hours walking distance from Pokhara; a famous tourist attracting place of Nepal. In my early years of primary school, I devoted most of my time to memorize numbers' names, their symbols, and multiplication tables and simply solved arithmetical problems. My routinized job was to memorize mathematical facts, formulae, and algorithms to solve bookish problems. The teacher miserly solved some of the selected problems and asked to solve the remaining questions by tomorrow. When I/we raised questions, the teacher used to provide readymade answers; these were the mathematics formulae, facts, and steps, you needed to grasp and retained whenever necessary. I had no option rather than following his guidance mutely. I have not found any fundamental changes in mathematics teaching learning activities from primary to university levels. These experiences led me to formulate different images of mathematics accompanying teaching-learning activities.

Deadly Symbols! Discoursing Teachers! Mysterious Mathematics!

*It could be any day of January 1988. It was my first optional (additional) mathematics class of grade nine. Prabin, Shital, and I sat on a second bench of the first row very enthusiastically as secondary level students. Our enthusiasm could not last long. Mr. Buddiman (our mathematics teacher) entered a class and a*sked us "*do you have an optional mathematics book"? We opened our book and looked at exercise five. To solve problems given in an exercise, we needed some important formulae. Mr. Buddiman wrote some symbols and formulae that were very strange for us. Most of the students' facial expressions were dramatically altered but no one* *could ventilate their feelings. I had never heard the name of symbols: - theta (and and their relations before that time. Mr. Buddiman solved some of the problems quickly and all of us copied hurriedly. At the end of the class, Mr. Buddiman urged us to solve question no. 7 and 14 of the same exercise by the next day. These deadly symbols, miraculous relations, their formulae, and procedures for proving the trigonometric identities created great vibration in my mind. I was in a state of confusion, whether I would be able to continue my study by taking additional (optional) mathematics and sciences as my future career subjects. Prabin, Shital, and some other friends shared the same experiences. I returned home having a bitter experience of the first day of my secondary level education. I shared my feelings with senior students who lived nearby my house. They also had the same types of experiences. I had another tension solving the questions for the next day. I solved those questions with the help of senior students and got some relief.*

The next day, Mr. Buddiman came to the class taking the students' register in his hand. He asked, "did you memorize the formulae, and did you solve the questions that were given yesterday?" He further said that everyone needed to learn the formulae to solve the problems of additional mathematics. Mathematics is a universal subject. All the students of the same level around the world study almost the same mathematical contents in the same way as our teacher suggested. It is a more important subject than other subjects. It demands continuous efforts and attachments. It has its language, symbols, definitions, formulae, facts, and axioms that do not need further elaborations and explanations. It is not our business to judge the truthfulness of mathematical facts, axioms, and theorems. So many mathematicians around the world have engaged in the development of mathematics and verifying its validity and truthfulness. Those who can devote enough time to solve the same problems many times given in the textbook and questions bank will succeed with good marks in the School Leaving Certificate (SLC)". After giving the nearly ten-minute lecture, he thoroughly checked the note copy of all students.

Approximately 60 % of the students solved the problems. Mr. Buddiman suggested to those students who were not able to solve the problems to shift to economics and geography group. Mr. Prabin raised a question*. Sir, it was our second day of the optional mathematics class. Was not it too early to decide the ability of the* *students? Mr. Buddiman seemed furious. It was your illusion. I have more than two decades of teaching experience. Do you know the proverb 'morning shows the day? If you follow the instructions then you will get success in your future; otherwise, it would be more ruinous for your future career. Most of the contents in optional mathematics are more rigorous, abstract, and need special ability, skills, and eagerness. You can take your own decision.*

Mr. Buddiman solved some of the questions on the blackboard and erased them immediately. Most of us could not imitate it. Immediately the bell rang and the class was off. We discussed the ways of his teaching and nature of mathematics that we were going to select as our additional subject thinking to open a wider horizon in our future lives.

After tiffin time, our Nepali guru (teacher who teach Nepali subject) entered the class. He spelled some of the names of my friends who were not able to solve the problems. He also repeated the same obligatory statement that largely discouraged us to take additional mathematics as a major subject. Such demotivating and deterring utterance of our teachers compelled Prabin and some other friends to decide to leave the optional mathematics as their future career subject. Here, my intention was not to blame our respected gurus (teachers) but I explicitly wanted to uncover hidden and scary mathematics practices in the Nepalese context at that time. These were some representative examples of my school years explicitly and implicitly rooted in our mathematics culture, teachers' beliefs, perceptions, and attitudes towards mathematics. These were reflected on their teaching and thus supported for germinating different images of mathematics. These devastating experiences of the early years of secondary level schooling created some confusions, illusions, and disappointment with the ways of mathematics teaching/learning practices. Such experiences helped to emerge disempowering images of mathematics as a collection of deadly symbols and mysterious subject. However, I persevered my journey with a firm desire of becoming a mathematics activist in the future.

From this incident, my early- day- images of mathematics as the collection of formulae and the symbolic game became stronger and took a form of a pile of deadly cryptograms. What I learned during my school years of education was that mathematics meant to reproduce these deadly symbols, formulae, and theorems by incorporating preconceived and pre-assigned methods or procedures. It stimulated me to form an image of mathematics as a mysterious subject (Lamichhane & Belbase, 2017; Sam, 1999) residing somewhere in the universe, uncontaminated from human activities (Ernest, 1998). I needed to climb such a deadly mountain crossing through a huge, deep, and terrible trench without artificial oxygenation, making a battle with death (Sterenberg, 2008). These adverse images of mathematics hampered my mathematical achievement and performances and gradually evaporated my actualization of mathematics as my favourite subject.

In the early years of schooling, I had secured the board first position but in the later years, I had not been able to maintain my previous position. I just secured the first division marks (60%) in the SLC examination. It indicated that my self-realization, confidence, and interest in learning mathematics have gradually eroded in the higher levels of education than in the earlier years of schooling (Mann, 2005; Parveva, Noorani, Ranguelov, Motiejunaite, & Kerpanova, 2011). These negative perceptions towards mathematics and mathematics teaching/learning activities culminated in the form of conventional images of mathematics that would have a long-term adverse effect on mathematical activities. Nonetheless, I had some sort of impulsion for taking mathematics as my future career subject. I thought that mathematics might help to generate highly payable and prestigious services. This hidden interest somehow became fruitful for me but it exactly would not foster the pure interest that is more empowering and authentic (Habermas, 1972).

My selection of optional mathematics as a future career subject was un/knowingly governed by utilitarian or mechanistic views (Ernest, 1994). These views of mathematics generally orient practitioners to control and manage the environment for a short-term personal benefit. I treat mathematics as a toolbox that resides on a dark corner of the house waiting for manipulation on a special occasion. Here, I want to articulate that the mathematical culture in the Nepali context nurtured me to incorporate an isolated unidimensional view of mathematics largely guided by technical approach of knowledge construction (Habermas, 1972).

The technical interest advocates that mathematical reality is out there in an objective form uncontaminated from human activities. Mathematics teaching/learning activities focus on discovering these realities as a form of mathematical knowledge with the help of experiments and external observations. The theoretical underpinning behnid this notion of knowledge construction is hypothetico-deductive approach in which all knowledge proceeds through certain propositional definitions, axioms/ postulates, and proofs. The hypothetico-deductive process of knowledge construction isolates knower and known (Dewey, 2001). Mathematical knowledge is constructed by some unseen eternal power and only some elite groups and their hegemonic cultural and pedagogical practices are valued and all other stakeholders are urged to become muted followers. What I witness is that our educational institutions are governed by such belief systems and the attitudinal orientations lead practitioners to form an image of mathematics as the mountain of deadly symbols and always remain obscure and mysterious.

My argument is that disempowering, demotivating, and scary pedagogical activities drive us to formulate the negative images of mathematics; however, it simultaneously opens a new avenue and helps transform existing conventional mathematics education towards more inclusive and authentic. For example, the development of non-Euclidian geometry is the product of the Euclidian geometry; modern algebra is the abstraction of arithmetic, etc. At this stage of inquiry, I have realized that creating confusion, tension, and dissatisfaction with existing mathematics practices is the beginning of alternative practices and transformative mathematics education (Papstamatis & Panitsides, 2014). What I have internalized is that conventional practices of mathematics education become one of the sources of developing largely negative images of mathematics. My understanding is that there is always a sign of glare in the sphere of darkness. This is one of the most important mantras in my life, which encourages me to choose additional mathematics as my future career subject despite having deadly images of mathematics as mysterious.

Encountering the Unconventional Mathematics!

My university education commenced in the mid of 1992 in one of the public colleges; Pinnacle Multiple Campus (Pseudonyms) located at Bharatpur, Chitwan. I started my educational journey hoping for getting solutions to some of my unsolved mathematical quarries during my school years. Most of the time, I got the same answer when I asked questions. Some of these answers were as follows: *It did not belong to our course. It will be found on a higher level. It was a mathematical fact and formulae. It was not so important for a final examination, etc*. I was rarely unhappy with an esoteric and tacit approach of mathematics education practices in school years and willing to engage in more democratic classroom practices that assuage past bitter experiences. However, my expectation no longer remained viable. My experiences of mathematics teaching/learning activities in the Proficiency Certificate Level (PCL) also resembled school years.

Discrete mathematical contents with a pile of theorems, tacit relation among them, strange symbols, lack of contextualization of mathematical concepts and examples, and poor teaching strategies are some of the causative forces for enhancing my images of mathematics as a mountain of deadly symbols and mysterious. Moreover, there are no particular textbooks written by Nepali writers, and almost none of the problems matched with our context. Our teacher simply picked up some of the decontextualized conventional examples from different textbooks and urged us to solve them. These mathematical contents and teaching/learning activities helped me to formulate an image of mathematics as an imported subject.

Our historical practices of measurement systems of land, mass, lengths, volume, etc. do not recognize and give value. These all are tagged as unstandardized contents. Almost none of the textbooks and reference books incorporate Nepali contextual examples and their relevancies in our daily lives. I do not claim that mathematical contents have not been applied in the different fields of human disciplines. Nevertheless, my argument is that these mathematical contents do not resemble our contexts. Almost all of the problems and examples are strange and unfamiliar to Nepali students.

Such decontextualized, unfamiliar, and strange contents and its reductionist disempowering approaches of teaching/learning activities have been contributing to germinate an image of mathematics as a foreign subject (Luitel & Taylor, 2005). Moreover, universality, certainty, rigidity, and value-free are some other characteristics of conventional mathematical practices (Ernest, 1998). It gives the impression that mathematics always deals with uniform shape, size, and tries to describe the physical world under certain frameworks. In my opinion, these are the illusions that have been created by absolutist views of mathematics held by teachers, students, practitioners, and novice researchers (Lamichhane, 2017). Such mathematics education practices destroy the creativity of learners and blends to reproduce so-called universal formulae, concepts, knowledge, and theorems. Such a dehumanizing *one-size-fits-all* approach creates havoc and deters mathematics education within four walls of the classroom.

It could be any day of July 1993; I had just arrived home after finishing the *final examination of Proficiency Certificate Level (PCL) first year. There were three strange people in my house sitting in an open yard discussing with my father. My father introduced me to them. Immediately two of them went next to my house and started to cut down some of the trees. They had already decided the price of timber Rs. 125 per cube feet. My father supervised the small garden in which workers chop down trees. Meanwhile, Mr. Junge (businessman) started to share his experiences. I did not have an opportunity to read and write so I have faced very difficulties to survive in this complex 20th century. At that time, there was no school in our small village. I lived in the Maghuwa near to your birthplace Tarkang. We had to go to the next village crossing the stream for schooling. It was dangerous to go to school in the rainy season. Every year some of the children in my village had been victimized by floods. I could not continue my formal education. I had learned some of the basic arithmetic operations, writing skills, and other fundamental knowledge necessary for solving the daily life problem from my grandfather. This knowledge and skills helped me in handling my small business.*

It was the time of calculating total cube feet of timber being sold. My father asked me to calculate the total price of the timber. I picked up my pen and copy and immediately reached in the garden where timbers were prepared to sell out. Mr. Junge said that 20 cube feet of the timbers were prepared. I could not make sense. How did he find the total volume of the timbers? None of the timbers was in the uniform shape that I had been learning in my school and university years. These looked like the cylinders. I could not determine their respective unique radii. I became bemused whether the volume of the timbers is 20 cubic feet or more. My father again wanted to reconfirm from my side that the calculation was right. Mr. Junge assured my father that the calculation was correct and gave a sum of Rs. 2,500. My father seemed furious and uttered some words indicating my meaningless education. Why did you need to study when you could not find a solution to such a daily life problem? In our time there was a book named 'Thulo Barnamala' (A book describes some basic skills of calculations and writing). If it is available now, bring this book and learns some basic skills necessary for daily life problems. Mr. Junge added that it is the product of the modern education system. My father agreed with him but I had no words to spell out. They added that it is worthless and meaningless education system. More than ten years of education could not be able to produce some basic skills in children. This event hurt me.

In my opinion, formal mathematics education practices in our schools and universities in/directly are guided by colonized mindset (Luitel, 2009). The colonized thinking of mathematics valued only those mathematical activities that are independent of time, place, and socio-cultural values. The western-centric worldview always argues about the universality of mathematical knowledge which is uncontaminated by human activities. Student and teacher are the consumers of a well-finished product of mathematical knowledge, which is highly decontextualized. We always discuss the front (final product) parts of mathematical knowledge without considering its invisible parts (ways of re/construction or invention of mathematical knowledge) (Hersh, 1997). In this context, I realize that our mathematics education practices have been largely guided by post/positivist unidimensional thinking.

The post/positivist thinking impedes mathematics within the frame of absolute reality, objective epistemology, and value-free notion of knowledge. It describes mathematics as the rigid and unchangeable pure body of knowledge (Luitel, 2013). The post/positivist thought regards mathematical learning as the acquisition or accumulation of pre-existing perfect mathematical ideas without questioning and critiquing its' basic foundations and evolution process. Mathematics has royal rules and procedures that the learners must master. It underpins hypothetico-deductive systems of discovering mathematical knowledge and its teaching/learning activities in which the learners are mute followers. I realize that the post/positivist views of mathematics groom learners to reproduce the pre-existing perfect concept of mathematics that is one of the hidden objectives of a conventional educational system (Bourdieu, & Passeron, 1990).

Mathematical practices of schools and universities do not acknowledge unconventional or emerging concepts, ideas, and problems as the mathematical knowledge with which learners from different communities and social groups are familiar. In such an adverse situation, the learners cannot assimilate the mathematical knowledge they have learned and might understand mathematics as only a way of seeking new mathematical knowledge. From this perspective, mathematics is regarded as a toolbox: full of rules, facts, axioms, unchangeable structures, and scientific logic to be used by the highly skillful individual for external recognition. It indicates that mathematics is discovered, but not created.

There is no significant role of the learner in the learning process. Most of the time is devoted to agglomerating a pre-existing body of the mathematical facts, concepts, and relations through the rote memorization and mastery process. The discovery view of mathematics ignores the unconventional mathematical facts and concepts because it is not in the standard form and is largely embedded in socio-cultural and livelihood activities of larger communities. Rather it reproduces the meaningless bookish knowledge and theorems, unconventional mathematical activities demand the deep engagement of the learners in the diverse fields. Deep engagement in emerging situations and problems that have been encountered in a personal, professional and socio-cultural life which help explore a new horizon of meaning perspective of mathematics, and its' socio-cultural and historical process of development (Mezirow, 1978). From the discourse, I apprehend that the conventional images of mathematics are no longer viable in the real ground phenomenon in which we encounter newly emerging situations that do not have a pre-existing solution. In this regard, I came to realize that my conventional images of mathematics implicitly/explicitly had been emerged by the influence of absolutist paradigms of mathematics and the transmissionist approach of teaching/learning activities.

Confronting Absolutist and Fallibilist Nature of Mathematics

During my academic and professional journey, I have been engaging in acquiring mathematical knowledge, concepts, and skills for getting good marks (grades) in a final examination held by school and university. Truly speaking, I did not have an opportunity to engage in a discourse of the nature of mathematics, its genesis, and the implication of mathematics in real-life phenomena. However, I got some opportunity to be familiar with a phrase nature of mathematics that had been incorporated in the university courses namely in teaching mathematics [Intermediate in Education (I. Ed.), Bachelor in Education (B.Ed.) and Master in Education (M.Ed.) levels]. In these courses, the nature of mathematics had been described as a science, art, language, deductive, logical, and universal subject. I felt proud to be a mathematics student and exhibited our supremacy over the students from other disciplines.

Universality, certainty, and consistency of mathematics help to sprout some positive beliefs and images of mathematics among the practitioners (Goodwin et al., 2014). However, its abstruseness, esoteric relation, and the tacit algorithms used in a name of proving theorems have made mathematics a more monotonous and uninteresting subject. I have some assumptions that learning mathematics is a difficult, hard and tough task; however, it could generate highly payable and prestigious jobs that would secure my future life. What I witnessed during my educational journey is that most of the students and academicians have initially involved in mathematics with their major goals of securing future jobs (Lamichhane & Belbase, 2017). What I want to articulate is that our immediate environment, societal influence, and economically deprived condition assist to evolve utilitarian images of mathematics as a toolbox. Such utilitarian images and instrumentalist thinking do not glorify the essence of mathematics and its pervasive roles in the world and the universe at large.

It was a weekday in the month of March 1994; I had started to study the nature of Euclidean and non-Euclidean geometry. Professor Gamvirman entered the classroom with some loose paper in his hand. Prof. Gamvirman started to write Euclid's postulates on a blackboard and we hurriedly copied these sentences without a sound understanding of their meaning and essences. One of my friends, Subodha raised a question on its meaning and significance. Subodh exchanged his views with the teacher telling him that we had already proved so many theorems related to Euclidean geometry, so why did we need this?

The Postulates

1. **A straight line can be drawn from any point to any point.**
2. **A finite straight line can be produced continuously in straight line.**
3. A circle may be described with any center and distance
4. **All right angles are equal to one another.**
5. **If a straight line falling on two straight lines makes the interior angles on the same side together less than two right angles, the two straight lines, if produced indefinitely, meet on that side on which the angles are together less than two right angles.**

Prof. Gamvirman replied that it is our course. It is the most important topic for your final examination. I felt so bored that in every question teachers had readymade answers.

I could not restrain my paroxysm. I raised some questions. What are the aims of education? Why do we need to attain university classes? Do we only prepare for the examination?

Prof. Gamvirman smiling slightly replied that Euclidean geometry is one of the most important branches of mathematics. It has its assumptions, definitions, axioms/postulates, and nature of proof. These postulates are mathematical conjectures accepted as universal truth without proof. Geometrical theorems and related calculations are completely based on these assumptions, definitions, and postulates. We could not raise a question on the truthfulness of these postulates. We simply followed it. The deductive *(axiomatic) approach was incorporated by all branches of mathematics. It was one of the most important achievements of 20th century modern mathematics, which helped maintain the uniformity in mathematics and its teaching/learning activities throughout the world. The deductive approach to mathematics has addressed the logical shortcoming of the different forms of mathematics practices around the world before that time.*

I am not fully satisfied with his arguments. Sir, what happened if these basic assumptions or postulates did not hold good? Did this branch of mathematics exist or not?

Prof. Gamvirman makes a joke: there is no need to discuss the falling down of the sky. He added 'you still do not understand the nature of pure mathematics. It is one of the most significant and powerful tools to analyze and describe the world more precisely. '

The above discourse of the nature of Euclidian geometry particularly and the deductive nature of mathematics generally insisted me to strengthen my images of mathematics as the universal body of knowledge. I realized that major sources of forming different images of mathematics held by the practitioner largely emerged through teaching/learning activities that have taken place in the Nepali mathematics classroom. Similarly, other significant forces behind the budding of such images of mathematics were teachers held beliefs, attitudes, and practices of mathematics (Belbase, 2013). In this context, I actualized that teachers were also the products of conventional mathematics education practice. Teachers' conventional images, beliefs, and attitudes towards mathematics implicitly and explicitly reflected on their teaching/learning activities and thus helped to formulate the same images and attitudes towards mathematics in their students (Jackson, 2008).

The conventional educational system produces such types of human resources who can simply perform a file duty (Grundy, 1987). From the prolonged practices of conventional mathematics education, Nepali students, teachers, and teacher educators are trapped in the mesh of absolutist thoughts from which they cannot easily escape.

The absolutist thoughts of mathematics exclusively emphasize absolute reality, objective knowledge, non-porous language, and hegemonic western cultural ideology (Luitel, 2013). The prescriptive nature of mathematics encourages practitioners to accumulate mathematics knowledge for future uses without questioning its reliability, validity, and truthfulness. Students do not require creative, imaginative, and critical minds for accumulating or collecting a pre-existing body of pure knowledge. Such incognizant activities gradually erode the creative, imaginative, and critical thinking of the students and thus school becomes a bad place for children (Holt, 2005). It simply focuses on transmitting mathematical knowledge from teachers to students. Mathematics classroom seems to be more autocratic and students do not get an opportunity to participate in free and pure discourse (Taylor, & Williams, 1992; Dhakal & Lamichhane, 2016).

Nepali mathematics practices are guided by the instrumentalist knowledge constitutive interest in which most of the time is devoted to producing technically oriented learners and dominant culture for the name of maintaining etiquette in school, society, and nation (Habermas, 1972). From this perspective, I came to conclude that our mathematics education practices tilt toward managing, controlling, and governing over the learners and imposing the so-called universal knowledge without consideration of their feeling, aspiration, needs, and motives.

It was a day in April 1994; Prof. Gamvirman disseminated the properties of non-Euclidean geometry. We were mutely listening to his lectures and making notes. Most of the time one-way communications take place. We were not highly enthusiastic to engage in discourse because of the nature of teaching/learning activities in which we were controlled in the name of maintaining disciplines.

Prof. Gamvirman explained Non-Euclidean geometry is a consequence of inadequate description of the parallel postulate of Euclidean geometry. Euclid's parallel postulate tells us that two parallel lines do not intersect if extended indefinitely. However, the hyperbolic parallel postulate states that the distance between two parallel lines does not remain the same. These lines might be asymptotic. Similarly, elliptic geometric doesn't consider the existence of parallel lines.

Prof. Gamvirman wrote hyperbolic and elliptic postulates in two columns on the blackboard. It gave tension to me. Where did such types of geometry exist? We were busy writing the key points. Immediately, breaking the long silence, Rupak spoke loudly. "Sir, I did not understand what you are teaching and could not make a sense".

Durga and Sarala also agreed with his argument. Sir, really we were not able to comprehend the nature of non-Euclidian geometry. As we were grown up by adapting the Euclidian properties in which every concept can easily be figured out. It was very *difficult for us to locate the lines and other configurations. The classroom became noisy, as almost all of the students had ventilated their feelings. Prof. Gamvirman became upset. He was not able to familiarize us with the surfaces or planes in which such geometrical figures can be traced out.*

Sarala expressed her views: Sir, in our previous classes you stated that geometrical postulates/axioms are such statements that are always true, certain, and invariant. Why these statements did not hold in non-Euclidian geometry? Did it signify that mathematical knowledge was not universal, certain, rigid, and consistent ?

I agreed with her. Sir, from our previous classes, I learned that mathematics is a branch of science in which there are some undefined terms, terminologies, axioms, and postulates accepted as universal truth and remain unaltered. Sir, am I right? If so, why the angle sum of a triangle gave three different values.

> Theorem: The angle sum of a triangle is equal to two right angles.
> Theorem: The angle sum of any triangle is less than or equal to two right angles.
> Theorem: The angle sum-of every triangle exceed two right angles.

Prof. Gamvirman felt some discomfort as the classroom was out of his control. Immediately the bell rang and he left the class.

From this incident, I became somewhat skeptical about the nature of mathematics. I have been pondering my journey of mathematics education. Why are such situations encountered in our class? Who are responsible? In my opinion, this is an influence of our historical practices of mathematics education, socio-cultural activities, and beliefs of teachers, students, and other stakeholders towards mathematics.

In my opinion, mathematics is the product of social, cultural, and historical activities. The most important factor we need to consider is that mathematics teaching/learning activities largely restrain us within the four walls of the classroom. The classroom teaching/learning activities focus on delivering the mathematical facts that are unduly collected by the textbook writers. Teachers and other stakeholders do not want to take sole responsibility for the teaching/learning activities. Such practices flourish the blaming culture that might victimize educational institutions.

According to Vygotsky (1978, as cited in Cook & Cook, 2005), firstly the child learns from society through social interaction with the help of languages, social artifacts, and cultural activities. From the very beginning, our mathematical culture orients to engulfing historically emerging mathematical contradiction (Ernest, 2015). It prevents students from becoming familiar with the historical process of mathematics development and its up-and-down movements. It indicates that mathematics learning within and out of schools affirms certainty, consistency, reliability, and invariance of numbers, quantity and calculations engulfs the back aspect of mathematics and manifests only the front aspect of mathematics practices (Hersh, 1997).

This view is tenable with the belief in 'Divine Mine' (Hersh, 1997). Lerman (1990) presented the absolutist beliefs of mathematics as a certain, absolute, value-free, abstract, and indubitable body of knowledge that follows a rigid algorithm discovered by great mathematicians (Pradeep, 2006). These beliefs of mathematics have been transferred from teacher to students and hence to society. It signifies that pedagogical activities in the mathematics classroom seem to rest on the philosophy of mathematics (Lerman, 1990).

Likewise, Ernest (2008) argued that epistemology and values of mathematics contributed to formulating different images of mathematics. Teachers who hold absolutist views of mathematics orient to adopting *one-size-fits-all* approaches of teaching/learning activities and thus help to formulate negative images of mathematics as difficult, cold, abstract, theoretical, ultra-rational, remote subject and inaccessible-to-all, except a few extra-ordinary people having 'mathematical minds' (Ernest, 2012). These negative images of mathematics are also related to anxiety and failure in mathematics.

Maths anxious individuals could not gain competence or mastery of mathematical operation and they have little confidence in their ability. (Probert, 1983; Preston, 1986; Pradeep, 2006). It creates a vicious circle of negative beliefs, low confidence and failure in mathematics, anxiety, and avoidance of mathematics. In this regard, I feel that for the betterment of mathematics education we need to transform our deep-rooted mindset of absolutism, certainty, objectivity, universality, and ideological singularity that are embedded in Nepali mathematics education. I realize that changing meaning perspectives in learner opens a new avenue for alternative mathematics education practices leading to formulate positive images of mathematics and thus offers more empowering, authentic, and engaging classroom teaching/learning activities.

From this discourse, I realize that there are two opposing poles of mathematical thoughts. Individuals who believe in absolutist thought tilt towards the transmissionist pedagogical approaches and do not recognize their role as an inventor of mathematical knowledge. However, fallibilist thought focuses on the invention of mathematical facts rather than discovery and blends with a constructive pedagogical approach. In my opinion, these views seem to the opposite and rarely incorporate the very nature of the genesis of mathematical knowledge, which is a more historical-hermeneutic process (Habermas, 1972). In my opinion, these are not contrasting views of mathematics. Both views contributed to developing mathematical knowledge. One becomes meaningless in the absence of the other and vice versa. At this stage of my inquiry, I came to conclude that the nature of mathematics is neither absolute nor fallible but complimentary. That is why Luitel (2013) called im/pure nature of mathematics. Mathematical knowledge is always imperfect and continuously enriching (Maheux, 2016) but at a certain time, place, and circumstance it seems certain and absolute. Over time, new thoughts, philosophies, and ideologies have been evolving and thus mathematics takes different paths accordingly.

Conclusion

In my experience, images of mathematics largely emerged through teaching/learning activities, interaction with the community, immediate environment, and larger socio-cultural practices. Initially, I took mathematics as the easiest and romantic subject as I easily uttered numbers names and performed basic mathematical operations. Gradually mathematics became more abstract, unfamiliar, and seemed to be impractical.

Further, I began to formulate images of mathematics as a collection of deadly symbols, mysterious and imported subject during my school years and these images became stronger in my early years of university education and added more images of mathematics as a decontextualized and an absolute subject. Later on, when I encountered with different types of mathematics in my bachelor level education, I formulated images of mathematics as an emerging social subject. Now, I realize that mathematics is not an isolated subject. It is a product of human activities and changes according to other human disciplines. Images of mathematics held by teachers and students influence its teaching/learning activities. My teaching/learning activities were largely guided by absolutist thought of mathematics in which I had been engaged in rote memorization, mastery of mathematical concepts and procedures, and propositional understanding rather than relational and cultural understanding. This research implies that to transform the mathematics education practices towards more inclusive and empowering ones, it is necessary to shift individual deep-seated conventional, essentialist, and foundationalist convictions, beliefs, and images of mathematics.

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