

Original Article

# My Journey of Learning & Teaching Mathematics as An algorithmic & Conceptual Problem Solver

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**Abstract:** This study study portrays my journey of learning and teaching of mathematics as an algorithmic and conceptual problem solver. I have explored and critically examined my learning experiences from primary school to university and my pedagogical practices using auto ethnography as research methodology and writing narratives as method of inquiry under the paradigms of interpretivism and criticism. Since the purpose of my study was to explore and critically examine my learning experiences and pedagogical practices from the perspectives of algorithmic and conceptual problem solving, I have used three grand theories as referents, namely Living Educational Theory, Transformative Learning Theory and Knowledge Constitutive Interests so as to explore and critically examine how algorithmic problem solving of mathematics gives rise to procedural knowledge of mathematics and how conceptual knowledge help students learn mathematics meaningfully.

**Keywords:** learning & teaching, mathematics, algorithmic, conceptual problem solver

## 1. INTRODUCTION

Great teachers are not born, they are made. Just as the most talented musicians or artists become great by reflecting on their art, beginning teachers become accomplished teachers, and skilled teachers become great teachers, by thinking hard about their teaching and finding ways to improve begun with my journey of learning and teaching of mathematics from primary school to university along with my keen interest towards “the contextualization of mathematics education that advocates both teaching and learning of mathematics are contextual” I discussed the critical journey of my educational life as a mathematics student and teacher [1]. I presented my lived experiences and contradictions that I have encountered during my journey of learning and teaching of mathematics. When I joined Kathmandu University School of Education (KUSOED) in for my master’s study, gradually I came to realize that there are many to learn for the improvement of my pedagogical practices. Moreover, I began to raise question to myself regarding my pedagogical practices that I have been proudly using in the classroom in the name of meaningful learning – “How do I improve what I am doing?” Therefore, my master’s study at KUSOED helped me dig out my teaching strengths and weaknesses [2]. As a teacher, I already spent about five years in teaching mathematics in different private boarding schools in Nepal and earned many pleasant and unpleasant experiences that really made me think about my ‘status quo’ of teaching practices and raised me the pertinent questions – Why do the most of my students dislike mathematics? Are my students enjoying my ways of teaching? Am I doing justice to my students? Are my students getting access of meaningful learning of mathematics in the classroom? Then, what could be the possible ways that could help my students learn mathematics meaningfully in the classroom? I developed it the foundation of my research agenda incorporating the following subheadings: Beginning

My Research Voyage (My Journey of Learning from School to University, My Journey of Teaching: Developing My Career, A Moment of Embarrassment : Eye Opening, Achievement of Students in Mathematics is Going Down, Mathematics as Bogeyman, God-Gifted: A Powerful Myth, Statement of the Problem, Purpose of the Research Study, Research Questions, Significance of the Research Study and Chapter Summary [3]. Finally, I used present tenses while writing this research report, and past tenses while presenting the narratives of past experiences. My research journey begins from here gradually articulating the research problems [4]. I still recall my joyful and painful journey of learning and teaching of mathematics when I would think mathematics as one of the abstract and logical subjects among all other subjects since the time I got sense of meaning making from what I learned in school [5]. Though mathematics is introduced from primary level of school in Nepal, I as a student and a teacher have experienced that many of the students in Grades 8, 9 and 10 do struggle to develop the sufficient knowledge and skills of mathematics [6]. I have found that many students have got distracted from mathematics learning and haven't gone to the field of mathematics in their higher study after School Leaving Certificate (SLC)/Secondary Education Examination (SEE) [7]. In my context, however, I was good at mathematics (probably good at algorithmic problem solving) during my schooling and hence continued my higher study in mathematics [8]. But there were/are many who gave up mathematics learning in their higher study [9]. What could be the possible reasons behind it? Why did I think that mathematics is all about abstract knowledge? Why did most of the students think mathematics a difficult subject? As a teacher, is my teaching method sufficient in providing meaningful learning of mathematics? When I was a school student, I still remember the bitter experience of not being able to convert mathematics into practices in my day-day to activities, for examples, I even didn't know – how the land is measured, how much carpet is needed for my room, how much water is needed to irrigate my farm land, what is the purpose of learning algebra and how it helps me in my life, etc. Such issues now have become key problems of my research study. As a novice teacher, I used to follow the traditional method of teaching (e.g. algorithmic problem solving, lecture, practice, chalk and talk, rote memorization of formulae, etc.), because that was how I was taught by my teachers [10]. When I became aware about the transformative learning after joining KU for my master's degree, I had two options – either I would enjoy traditional teaching method or would I transform my practices. However, my heart and mind did not allow me to preserve the status quo, that is, the first option, rather I started thinking critically towards my own practices and beliefs about mathematics teaching approaches [11]. In due course of my master's study, I began to critically explore the different teaching approaches and research methods via different literatures while and after going through the literatures, I began to reflect on both of my learning and teaching experiences. When I reflected on my learning experiences, I still recall my mathematics teachers saying: Memorize all the formulae and I will ask you tomorrow; Practice until you can solve the problems; Learn the steps by repeated practices; Always follow my methods and steps of solving the problems; Mathematics is best learned after practicing many times; etc. As a child learner, I had, perhaps, no any options of following the methods other than that of what my teachers instructed in the classroom. As an honest child learner, I developed myself as “a linear learner” (Shrestha, 2018) and followed the footsteps of my teachers in a linear way and became honest towards what and how they taught me during my schooling as if there were no any alternative methods of solving the mathematics problem. Similarly, when I reflected on my beginning phase of teaching practices, no doubt, I began my teaching career by following the footsteps of my teachers in a linear way. Being graduated from pure mathematics and having no any idea of educational practices (e.g. teaching and learning approaches) [12], I had no or less idea about whether my linear ways of teaching had done full justice to my students in terms of their meaningful learning. However, I was much confident that I was able to transmit knowledge and skills of learning mathematics so that my students were able to solve the algorithmic problems and find the correct answers. But my master's study was an intervention on my beliefs about my traditional ways of teaching (algorithmic problem solving with

'chalk and talk' and practice methods) [13]. Since then I began to compare and contrast my traditional teaching practices with my recent practices and hence realized that many changes had occurred in my practices and beliefs towards teaching and learning processes. Nevertheless, I don't claim that I have now become a perfect (transformed) mathematics teacher. Rather I have realized that learning is a continuous process that always helps me improve my teaching practices according to time and context [14]. The purpose of the study is to put forward and share my experience of teaching and learning mathematics and to explore and critically reexamine how procedural and conceptual knowledge helps students to learn mathematics meaningfully in the classroom [15]. For this, I believe that critically analyzing about own beliefs and practices is a major and necessary task to move ahead. Also, to explore how I transformed myself from algorithmic problem solver to conceptual and meaningful problem solver. In doing so, I attempt to give details of and critically assess my deep-seated beliefs, stories of practices, changes occurred in my beliefs and practices during the process of teaching and learning mathematics [16]. Auto ethnography is the way of reflecting own experiences as a student and teacher of mathematics. Evaluating my own beliefs about mathematics learning strategies provides me a chance to reflect myself as a mathematics learner and teacher [17]. It will help to develop as a critical learner to examine my values and beliefs. I think this study plays an important role to incorporate algorithmic and conceptual problem solving approaches in teaching-learning mathematics. I don't have anything to claim at this stage apart from me becoming aware of my own limitations [18]. To those who are still following teacher centered, text book centered classroom practices and suffering from different worry may get some insights from my study. From this study, teachers, students, parents, curriculum reformer etc. who want to envision for change regarding pedagogical practices might be of benefit. This research helps to understand about my teaching and learning method, my experience on teaching and learning [19].

## 2. MATERIALS AND METHODS

The methodology which I used in my research, and gave an overall framework of my research. I am conducting research using qualitative methods, so it is necessary to explain the notion of qualitative research. That's why it began with the explanation of qualitative research and secondly paradigms which are interpretivism and criticism. I wrote narratives which were related with my experiences as student and teacher of mathematics education. So, in qualitative method I choose auto ethnography as research method. It includes the following headings: Research Paradigms, Ontological Considerations, Epistemological Considerations, and Axiology, Auto ethnography as a Research Methodology, Source of Narratives, Ethical Issues, Quality Standards, and methodology of my research. I have described clearly about how the research is going to be conducted. Furthermore, it helped me to design the framework for overall my research. So, it focused on selection of my qualitative research paradigm, I used multiple paradigms in my research design where interpretivism helped me to explore my lived experience of my pedagogical practices as learner, teacher and novice researcher. Criticism enabled me to reflect emerging issues critically finger point to self and other. I have used auto ethnography to embrace the notion of multiple paradigms which helped me to identify and examine my lived experience enabling me as a transformative learner. I also have mentioned different logics and genres as method in my inquiry. I mentioned my research methodology as auto ethnography, writing narrative as a method of inquiry, source of narrative, ethical issues, quality standards etc. I used four quality standards; verisimilitude, critical reflexivity, pedagogical thoughtfulness, and transferability to ensure the qualities under different paradigms.

## 3. RESULTS AND DISCUSSION

It is devoted for some of my experiences of teaching learning mathematics as a student as well as a teacher. I presented different experiences in the form of narrative, stories, dialogue and poems. All the

stories, poems, dialogue presented in this study show the picture of traditional teaching and learning and its negative impact on meaningful learning mathematics. In this chapter, I address my first research question; how did I learn mathematics in my school, and how did I apply algorithmic problem solving approaches as a novice teacher? First, second and third narratives shows my learning mathematics in school level and fourth narrative shows my teaching mathematics as a novice teacher. There are four sections in this study namely; you are good for nothing except Playing All the Time, Easy to Memorize First but Confusion At Last, If then When will You Read Formula? After SLC Exam! , Algebra is like climbing the Hill!!In this chapter, I have presented how I learnt mathematics in my school and how did I apply algorithmic problem solving approach as a novice teacher. I came to understand that, although, conceptual and procedural both knowledge are necessary in mathematics learning, mostly we have to focus on conceptual knowledge for the meaningful learning. Hence, conceptual knowledge helps the students to remember the particular problems for long time. According to teaching concepts before procedure be beneficial and more effective in the long term. For the effective learning, learners should aware about implementation of his/her learning in their daily life so that they focus on their study.

### Discussion

In this chapter, I tried to share my own experiences of transformation of my beliefs about pedagogical approaches of teaching and learning mathematics through the real classroom teaching [20]. I addressed my second research question in this chapter; how did I transform myself from algorithmic problem solver to conceptual and meaningful problem solver? For this, I present how I used to feel fear to adopting new things at the beginning, and how I shifted from one notion of mathematics to other [21]. The narratives of my shift from the algorithmic problems solver towards the meaningful problems solver provide meaningful opportunities to make sense and use of mathematics in our daily life [22]. There are six sections in this chapter namely No, sir! I can't sit in his Class!, Yes sir, we find this Chapter Very Interesting, Sir! We clearly understand it, yes, sir, We know the formula meaningfully and chapter summery. No, sir! I can't sit in his Class. It is difficult to remember the past. However, we know the past is experience and the present is experimentation and the future is result [23]. It could be one day of in this chapter, I have presented how I transformed myself from more algorithmic problems solver to conceptual problem solver. I came to understand that conceptual knowledge provides meaningful learning which encourage the students to solve mathematical problems [24]. If they know that mathematics is useful in our daily life, they motive themselves to learn better. So that every student started to love mathematics and showed the positive attitude toward mathematics and because of this I also started to change my teaching method towards conceptual and meaningful. Shrestha mention that local and cultural mathematics can also be one of the components for meaningful mathematics learning [25]. In the above episode, I had connected the particular topic of mathematics to the local mathematics so that students were interested because of their realization that mathematics is one of the subjects which is practicable in our daily life.

### 4. CONCLUSION

It focuses on the conclusion of my study, I already prepared the five chapters but this study takes a longer time to write. I have to recall all activities in this chapter. While I am going to start, my hands do not work although mind is guiding something to write. My fingers touch the key board of my laptop, but no words were typed. Although it happened to me, I remember my friends, teachers and thesis supervisor who gives me great inspiration to complete my dissertation and try to write some things to conclude my study. Knowingly or unknowingly, I have to come to this stage. All the time, as a student, as a teacher or a novice researcher, my mind is going to re-examine how procedural and conceptual knowledge helps students to learn mathematics meaningfully in the classroom. So, I try my best to deeply study about my research on the basis of my experiences. Actually, purpose of the study was to

explore and critically re-examine how procedural and conceptual knowledge helps students to learn mathematics meaningfully in the classroom. For this, I presented my real life experiences how I transformed myself from algorithmic problem solver to conceptual and meaningful problem solver. In this chapter, I recall all the activities from the beginning to the end of this document to represent my ways of this study including my research dilemma, looking back at my research questions, implication and future directions.

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