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Learning to Teach Mathematics for Social Justice: a Dialogic Reflection

Abstract

This study explores the entailments of learning to teach mathematics for social justice by actively engaging six elementary school teachers in a critical research process. Where in the researcher who is an elementary teacher herself collaborates with the other teachers to explore critical mathematics education through a task based programme. The goal is to blur the distinction between research, learning, and action by providing the researcher and the participants opportunities to collectively engage in a reflective dialogue towards social justice and in the process enabling each one to actualise their ways of knowing and growing to sustain their growth throughout their careers.

Introduction

As teachers of mathematics, we have always taught our students to solve the pseudo problems that exist in the textbooks but not the real problems which exist in their lives (Fasheh, 2015). These are the problems which are part of their existence; which are rooted in their culture, caste, gender, socio- economic background causing social injustice. Learning to understand and solve these problems would mean attaining critical literacy (Friere, et al. 1997). Creating space for these problems in a mathematics classroom by mediating it with everyday mathematics (Rampal, 2015) is the new approach towards mathematics education being proposed by educators like Frankstein, Gutstein, Skovsmose. It challenges the traditional value free mathematics and utilises mathematics as the most powerful venues for working towards the goal of critical pedagogy (Freire,1997). In the most general sense, critical pedagogy enacted in the mathematics classroom adopts the pedagogical theories and practices of critical pedagogy, while explicitly using mathematics as an analytical tool for examining and challenging social injustices. Or said more directly, critical mathematics pedagogy is most often framed as teaching mathematics for social justice (TMFSJ).

Teachers' commitment to social justice and to their students is what teaching for social justice and teaching to change the world is about. This approach seeks to deepen students' understanding of society and to prepare them to be critical, active participants in a democracy (Gutstein& Peterson, 2005). An additional characteristic of teaching math for social justice involves students posing their own problems (Gutstein, 2006; Gutstein & Peterson, 2005). Through problem posing, students learn how to formulate questions that make sense given certain mathematical information while also enhancing their mathematical attainment

(Frankenstein, 2005). Furthermore, real world problems emphasize the fact that clear-cut, neat solutions are commonplace only in mathematics textbooks, "real life is messy, with many problems intersecting and interacting" (Frankenstein, 2005, p. 21). Students need to understand that not all problems have solutions or that there may be multiple and sometimes varied solutions to the same problem. The recognition that the world is textured and that mathematical answers are not "truth," but rather options and opportunities, is an important lesson in critical mathematics education. If school mathematics introduces students to questions of limited depth that only acknowledge superficial ideas, then students only understand mathematics to be a simplistic tool. But in the hands of an aware teacher, who recognizes how critical thinking can transform mathematical answers into evident seeking instrument, students begin to acknowledge their own agency in transforming themselves and their community (Gay, 2009). Mathematics teachers who teach for social justice encourage their students to solve the same problem from the perspective of different members of the class, school and community. These teachers embrace multiple solutions and methods and focus on questioning as part of a critical understanding of the world through mathematics. Furthermore, collaboration and exploration is valued. When teachers introduce students to the ethical consequences of mathematically-based decision-making, students learn to use the most important tool available to create change in their lives and their world: understanding social justice through the lens of mathematical evidence.

The critical mathematics education requires specific ideological orientation of the teachers, this is conflicting to the 'traditional image' of mathematics held popularly (Ernest, 2001). Research indicates strong connections between the teachers' beliefs about mathematics philosophy and their teaching practices (Thompson, 1992). This new orientation of school mathematics not only challenges teachers' ongoing classroom practices but their personal beliefs about mathematics teaching and their image of mathematics as well. Many teachers have the same conception of mathematics that their previous teachers and texts presented. Ernest (2004), explains that most of the beliefs about mathematics are developed in the school and especially the mathematics classroom, he suggests that negative image of mathematics largely comes from school experiences. They internalize the "reified typification of mathematics" and it's difficult to learn and succeed image (Frankenstein, 1990). By the time the aspirant is admitted to a teacher education programme, these beliefs about how to teach and learn are deeply embedded in the individual, and very often are reinforced by the traditional nature of some teacher education institutions which may not have positive effects on preservice teachers' mathematical beliefs (Kagan, 1992). There is evidence that, in some cases, teacher education programmes are so busy concentrating on imparting pedagogical knowledge that little consideration is given to modifying these beliefs (Tillema, 1995 as cited in Handal & Herrington 2003). Most of the in-service programs are based on lecture method and are not aligned to the needs of the teachers' (NCERT, 2006). Ironically, even the approaches like activity based learning are delivered as lectures, leaving no space for reflection and inquiry. Consequently, teacher education programmes might have little effect

in producing teachers with beliefs consistent with curriculum innovation and research (Kennedy, 1991 as cited in Handal& Herrington, 2003). Therefore, teachers need to be assisted by the mathematics teacher educators and programmes in learning to become critical mathematics teachers (Bartell, 2006)

Despite the potential, teaching math for social justice has in addressing issues of social justice in mathematics education, little research exists that examines mathematics teachers learning to teach for social justice, a necessary step in beginning to understand the entailments of teaching mathematics for social justice (Gau Bartell, 2005, p. 3). This study recognises the dearth of research in this field and therefore, attempts to contribute in this area by inviting teachers to participate in a task based programme designed to learn mathematics for social justice.

Theoretical Foundation

The critical mathematics pedagogy has its roots in critical theory; therefore it was believed that the teacher preparation also needs to be done in the critical paradigm such that teachers get to live what critical pedagogy may mean to her own teaching. In this regard, this study has been profoundly influenced by the work of Pualo Freire (et al. 1997). Freire modelled critical theoretical research throughout his career as he was concerned with human suffering and the pedagogical and knowledge work that helped expose the genesis of it. In his writings about research, Freire maintained that there were no traditionally defined objects of his research—he insisted on involving the people he studied as *partners* in the research process. He immersed himself in their ways of thinking and modes of perception, encouraging them to begin thinking about their own thinking. Everyone involved in Freire's critical research, not just the researcher, joined in the process of investigation, examination, criticism, and reinvestigation—all participants and researchers learned to see more critically, think at a more critical level, and to recognize the forces that subtly shape their lives. Freire, suggests development of teachers' critical consciousness—which he maintains can emerge only through dialogical, problem posing education that moves past reflection towards action. Thus the goal of Freirian research is to blur the distinction between research, learning, and action by providing the researcher and the participants opportunities to collectively engage in the struggle toward social justice; it encourages researcher-participant reciprocity, turning participants into co-researchers while providing the means for researcher and participants' *self* empowerment (Kincheloe, 2012).

Overview of the Study

Teachers are a critical part of mathematics education research and should have access to the outcomes of that research, a methodology that intimately involves teachers as participants are essential. The study thus employed Freirian participatory research; where, the participants were the co researchers of the study. As part of the study, a formal group was created, where in six elementary school mathematics teachers and I (elementary teacher myself) critically analysed my beliefs about self, student, society and school (Darling-Hammond, 2002) with respect to the teaching of mathematics. We worked around the issues and prospects of teaching math for social justice. Analysis in this critical tradition took the form of self-conscious criticism—self-conscious in the sense

that researchers try to become aware of the ideological imperatives and epistemological presuppositions that inform their research as well as their own subjective, intersubjective, and normative reference claims (Kincheloe, 2012).

I entered into this research with the hope that by working with teachers around issues of teaching math for social justice, they too would see the value in such work and introduce these practices in their classrooms. Therefore, I looked for the participants who were keen to explore mathematics in a more libratory form. All the participants expressed interest in the study, a desire to work for a more socially just society, and strong emotions of love and hatred towards mathematics in their initial interactions with me. Teacher's intellectual isolation and lack of network is widely accepted in the field of teacher education and the ineffectiveness of in-service programmes is also agreed upon. In such a scenario, participants' willingness to be a part of this study was my only reason to have them as my co-researchers.

The teachers and I initially engaged ourselves in an introspective exercise, where through personal stories we took a journey into our pasts and attempted to position our beliefs about self, student, school, society and mathematics for a collective critical inquiry. Telling stories is a dialogic process, within the self and with others (Holland et al, 1998).The storyteller makes meaning of herself in a space within the self and with others. Bakhtin (1981 as cited in Moen, 2006) uses the term internally persuasive discourse to call attention to the dialogical process of personal story telling. Teachers' narratives thus position them and give them open opportunities to understand how their experiences lead to reflections, insights and queries about their beliefs about mathematics and its teaching and learning. This process helped each of us involved in this study to reflect on the teaching practices and explore queries about the professional decisions. It led us to ask questions like: What do stories about experiences with mathematics tell me about my fears and anxiety and how they provide a window into the way my teaching practices are affected? How do my beliefs about the learner's background and her position in the fabric of society affect my aims of teaching?

We then engaged in discussions and worked with content-specific resources such as academic articles, lessons, projects, videos and activities focused on the teaching of math for social justice. Through readings and discussions, teachers explored the meanings behind teaching math for social justice, what it means to be an agent of change, what our own position in society is, and how our positions and histories might influence our pedagogy. The most important component of each session was to raise our consciousness towards the social and political issues. We discussed our political orientations and its relevance in our teaching careers to achieve the goal of social justice. It was not easy for the teachers to extend their roles to incorporate the issues of inequities and unfairness in the practice. They resisted as their belief about their role as a teacher was that of neutrality and not that of revealing political alliances.

The data collected for this study included autobiographical writings, discussions, and open interviews with the participants. Multiple data sources were relied upon. These included narratives-written and oral, semi-structured initial and exit interviews of each participant. Participants also wrote written reflections in and at the end of group meetings. Additionally,

I wrote written reflections at the end of each group meeting and kept a running journal of thoughts and ideas throughout the study aimed to keep a track of my own subjectivity. The teachers wrote reflective essays on their personal image of mathematics and were involved in group discussions by being part of designed tasks. By exploring stories on multiple occasions, both participant and researcher made sense of the experience. Therefore, data was not merely meant to be analysed by the researcher but was of greater significance where it formed the thrust of inquiry for each of the participants. It was used for igniting discussions and for engaging teachers in the process of problematization (as conceptualised by Freire). This ultimately led us into a process of dialogic reflection; where we did the task, share experiences, reflect collectively, write the narratives, and discuss our stories with agreements-disagreements, supplementing or complementing each other's ideas and perspectives. Each session was the site of further nodes of inquiry taking the dialogue ahead. The nature of the tasks was such that they engaged teachers in dialogue about the role, culture, language, class hold in mathematics learning and teaching with the explicit emphasis on social justice that utilizes mathematics as a tool to challenge and change social inequities.

We revisited the primary mathematics textbooks with the newly acquired orientation and attempted to create units of study keeping our own students and their backgrounds in mind. This task was preceded by exposing the group to the resources presently available that could serve as examplers for the unit of study we later created. What was important here was the process and not the product, the discussions which went around various issues made it worth an experience. These discussions had a new language, where we were using the phrases like, 'will it interest the students', 'will they relate to it', 'how will they collaborate, has anybody thought about it', 'will this help them understand the critical issues'. These phrases were suggestive of our objective of making units of study which were meaningful and engaging to our students. Some of the units were parallel to the units we discussed and studied in various existing and available resources. However, these units had their very own contexts and were related to the student's life in their own distinct manner.

Reflections

The 'participatory action research' nature of the study, which invites people to participate in the co-creation of knowledge about themselves, proved to be instrumental in changing the power relations(Pajares, 1992; Skott, 2014). We proceeded collaboratively and ensured that research is owned and controlled by research participants as well as the researcher. The aim was to reflect, explore and disseminate the views, concerns, feelings and experiences of research participants from their own perspectives making the dialogue more local and contextualised, which is the basic tenet to teach mathematics for social justice. Participatory research also provided a voice for the participants; teacher's voices which often get lost when they are studied objectively in the positivist academic research (Kincheloe, 2012) were recognised in this study by raising their consciousness by advancing an agenda for change (Creswell, 2005, pg 9).

Teachers gradually recognised their beliefs and myths related to mathematics and become aware that their teaching required a change. In one of the narratives, a teacher mentioned that she had always believed that "doing

mathematics requires high IQ and only talented children can perform well in mathematics" and now realised that she has been neglecting many of her students only because of this belief. They realised that they were also lowering their expectations as they felt that the children from the marginalised groups should know the basic mathematics which is more than enough for them. Lowering the standards of pedagogy and learning outcomes is a very common response of teachers teaching the children from marginalised group (Villegas & Lucas, 2002; Gay,2009). We teachers were harnessing many such negative dispositions; denying respect and equitable opportunities to those who are already deprived was one such negative disposition.

We learnt how mathematics play a central role in its politicized position and status in relation to knowledge and intelligence (Gutstein,2006; Skovsmo,1994). Thus, to deny others the opportunity to engage in the process of mathematizing the world- to utilize mathematics to make meaning, connect to other forms and knowledge and inform decisions-is an act of dehumanization. But, the teachers learnt that our policies are very clear on this note. NCF 2005, proposes 'mathematics for all', it stands for quality mathematics education which is for everybody irrespective of their class, caste, gender and access to quality mathematics education is every child's right.

Once many such beliefs were recognised by the group, they became confident to shed them and were more open to learn about new orientations. This study helped them become more sensitive towards their students and their lives, by helping them recognise that their privilege identity act as a blindfold to recognise the problems their students are dealing every day. The study not only gave them a new language but also a legitimization to transform their pedagogical philosophies and practices away from the "traditional" and toward a mathematics for social justice.

Though they expressed both support for and concern about teaching mathematics for social justice, the teachers began to envision their classrooms as places where social injustices could be examined through mathematics. They identified many issues they wanted to intervene through mathematics like body imaging through the concept of proportion, water conservation through the concept of ratio, menstrual health and hygiene through the concept of Time and Calendar and the concept of Profit and Loss. They actively started seeking critical connections with other disciplines. They were able to see the connections in the curricula especially the mathematics textbook and classroom environment. They were establishing channels of communication with me, students and colleagues. By providing stories of their own experiences as learners as well as through their contributions to our discussions, the teachers led me to a deeper and distinct understanding of what schooling is like for students from marginalized communities.

Our awareness of certain social issues increased and we found ourselves getting involved in the social causes we as group cared for. They also helped me improve in organising sessions by providing constructive feedback after every session. Time management, complexity of readings were some of the concerns they raised for me to improve on. In general, we were able to see ourselves as stronger facilitators.

They responded positively to the professional development experience and expressed their interest in the

topic, the usefulness of the work and the supportive environment of the group. The findings report that the teachers believed that the study provided them the confidence to regain their academic strengths. Many of the teachers were themselves struggling from 'Maths phobia' which they were able to shed as they engaged themselves in the process of learning to teach mathematics. They realised it was their 'traditional beliefs' such as mathematics is all about 'speed and accuracy' that they feared mathematics. They also reported that they are now confident to read the literature on education which they were not reading ever since they had come out of their teacher preparation programmes. They compared this journey to the other in-service programmes and reflected on how the two processes differ. One of the teacher said "we were able to address things or issues that meant something to us as opposed to people telling us what, exactly, we had to do". This programme allowed them to go back to their classes and come back with the queries unlike the in service programmes where they never get the opportunity to return to the group for further discussions. Through this inquiry there was recognition of the consequences of beliefs, knowledge and experiences on what and how one teaches. They recognised better who their students are, where they have come from, what they themselves know and what their students need to know. They framed and reframed the issues and problems they face. The exposure to the outer world, to new research perspectives and studies, newer approaches and the process of self and group inquiry is what they now take as part of their professional development. One of the teachers acknowledged in her narrative that, "for the first time in my career, I have realised that I was like a 'frog in the pond', who had no idea of what is going on in the world". We all found ourselves moving out of the boundaries of our practice, be it the physical boundary or cognitive. This process of stepping back, description and reflection became a kind of articulation or process through which we clarified our tensions, making us more free, thoughtful and mindful of actions.

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