

Exploring Implications of the Social Model of Disability for Mathematics Education

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Contents

Acknowledgements	i
List of Publications	ii
1 Introduction	1
1.1 Background	2
1.1.1 Motivation for the research study	4
1.2 Overview of thesis	6
2 Review of Literature: Contending theories on Disability and Mathematics education	8
2.1 On Disability Studies	8
2.1.1 The Social Model of Disability	11
2.2 Social model vs Human rights model	12
2.2.1 The Postmodern turn in disability studies	13
2.3 On critical mathematics education	18
2.4 Vygotsky and social learning	18
2.5 Economy, Schooling & Disablement	19
3 Research methodology	23
3.1 Research Methodology	24
3.2 On Case Study Research	24
3.3 Limitations of case study research	25
3.4 Theoretical Perspective	26
3.5 Research Objectives (While beginning the study)	26
3.6 Research Questions	27
3.7 Research settings	29
3.8 Corpus of Data	29
3.9 Sampling	30
3.10 Ethical considerations	30
3.11 Access, consent and confidentiality	31
4 Study 1: On Inclusive learning	32
4.1 Individualization versus collective learning	35
4.2 Can blindness <i>really</i> need not mean disablement	37

4.3	Three components of inclusion	39
5	Study 2: Limits of Inclusion - Beyond the Classroom walls	40
5.1	Background	40
5.2	Contradiction of production and realization of mathematical proficiency .	42
6	Concluding analysis: So what does the social model of disability mean for mathematics education?	44
6.1	Some implications of the study	46
6.2	Further questions	49
	 Bibliography	 50

Chapter 1

Introduction

The research study presented in this thesis is an outcome of my attempt at exploring what “the social model of disability” could mean for mathematics education. This question was investigated through a case study of a learning centre for blind children located in Mumbai.

The social model of disability begins with a rejection of the widely held assumption that disability is a direct outcome of bodily limitations, and argues instead that disability is socially produced. The social model is based on the assumption that social problems faced by individuals cannot be understood merely by studying individuals in isolation, and one must take into account the functioning of society as a whole and how individuals and their problems are embedded within a social structure. For example, from a social model perspective, we see that the exclusion of certain groups of people (for example, blind students) from the institution of schooling cannot be meaningfully understood or addressed without looking into the nature of the institution of schooling, its history, its interconnection with the political economy, the history of the country and society within which the school is located, etc.

But what can the social model of disability mean in the context of being confronted with the concrete question of teaching mathematics to blind children in a way that does not further reinforce their identity as “special” or “differently abled” students? This question is certainly not easily answerable, and forms the crux of the research study presented in this thesis.

1.1 Background

The research study presented here began with a chance visit to a nearby study centre for blind children in June 2013 and culminated into my PhD research project. The study centre catered to partially/completely blind students most of who attended regular schools (with blackboards and teachers with no knowledge of Braille). Around 45 students were registered with the centre as of 2013, almost all of who were from economically lower to lower middle class backgrounds. Some students were not part of any formal school but came to the centre to study for their open schooling exams. Prior to being a part of the study centre, these children were confined to their homes and barely received any education. The National Association for the Blind (NAB) sent teachers to individual children's homes twice a week and were taught for two hours.

During our conversation with the teachers and manager of the study centre, they expressed their need for someone who could teach music and English speaking. I went back and returned with my guitar. Subsequently, we were given a two hours slot on Saturdays between 11am to 1pm to keep the children engaged with activities related to music and other forms of recreation.

I particularly did not wish to look upon our visit as a research opportunity. We did not plan to return to the centre let alone maintain a relationship that lasted six years and counting. Although I was interested in pursuing mathematics education research, I did not wish to pursue my field study with students with special needs since among other reasons, I did not have any formal training in special education. Also, I did not have any working knowledge of either Braille or sign language. Further, the first language of most of the students was Marathi which I had a difficulty speaking.

However, the question of teaching mathematics to blind children significantly bothered me owing to seeing the children at the centre struggle with memorizing definitions of mathematical concepts. The children's struggle had less to do with learning and understanding mathematics and more to do with rote learning answers to textbook questions with the aim of passing their mathematics exams. The curriculum content was unarguably alien to the children. My immediate thoughts on the matter was that, "what they are struggling with is not mathematics!" A meaningless mathematical curriculum was being imposed on the children. And this put me in a dilemma. On the one hand, it was cruel for them to be made to mechanically rote learn answers in a subject which was evidently designed for sighted children. But on the other hand it would have been worse if they were denied the right to be trained in curricular mathematics.

Nevertheless, we maintained our weekly schedule of going to the study centre every Saturday where we began our sessions by singing songs and followed it by activities

related to mathematics and science. We also had discussions related to mathematics, science, and social issues. These activities helped us develop a rapport with the children. While initially, our interactions were limited to recreational activities on Saturdays, the students and the teachers requested us to volunteer to tutor during exams. In the following months, in addition to the Saturday visits, on weekdays, we volunteered to read their text books to help them study for their exams. I also helped prepare notes for them to memorize. While tutoring the children, they often digressed from the topic and spoke about their personal experiences. Interestingly, normative mathematics educational practices featured significantly in their narratives.

For example, a student who I'll refer to with the pseudonym ¹ Faiz narrated an incident of playing a maths game with his (sighted) sister. Faiz narrated how in the midst of the game his sister excused herself and returned with a paper and pencil. Faiz lamented, "If mathematics is something done in the head, why is there such a heavy emphasis on using a paper and pencil?" I found it quite a pertinent concern. Faiz also expressed his discomfort with questions based on diagrams given in the book and unnecessarily long equations in Algebra.

Another event that triggered my interest in the research project was that of another student, Rina narrating her experiences of being discriminated in her school. Rina is a dalit girl who was blind from birth. While it did not come across as shocking that a visually challenged girl was discriminated against in a semi-private school, what struck me about her narrative was the part where she contrasted her experience with that in her previous school in which she claimed to not be discriminated against. Both were "normal" schools (with blackboards, teachers without knowledge of Braille or Sign language, etc.). By comparing her experiences in the two different setups, it became evident that Rina's enablement and disablement had more to do with the culture of her social environment than her "ability" and "disability". It was not her disability that led to her exclusion but rather it was exclusion and discrimination that led to her disablement in the semi-private school.

Without a theoretical grounding in disability studies, I conceptualized these incidents as being in one way or another, an outcome of the students' blindness. However, my PhD coursework on weekdays that accompanied my Saturday visits coupled with my stumbling across a paper by Michael Oliver (1990) on the Social Model of Disability compelled me to change my perspective towards these stories and helped me develop a different outlook towards the question of teaching mathematics to blind children.

¹Names of all participants mentioned herewith are pseudonyms.

1.1.1 Motivation for the research study

The concept of the social model of disability seen through the lens of the narratives of Rina and Faiz were particularly instrumental in developing my understanding of the social nature of disability and the relationship between discrimination and disablement. I also found that to a large extent, (Mathematics) Education practices that addressed disability stemmed from standpoints in which disability was equated with some form of deficiency. But there were exceptions, namely with mathematics education researchers who engaged with what they referred to as Critical Mathematics Education. Analogous to how the social model questions taken-for-granted assumptions about disability, Critical Mathematics Education (CME) questions what we take granted as mathematics education. CME and the social model of disability share a common feature of trying to understand society as a whole, along with its political and economic dimension, while locating the particular object of analysis (disablement or mathematics education) as embedded in society and existing in a dialectical relationship with it.

[Marcone \(2015\)](#) spoke of the dominance of the deficiency perspective in mathematics education through the notion of what he called, *deficiencialism* which referred to *deficiency* as a construction of *normality* ([Skovsmose, 2016](#), p. 3). Recognizing the prevalence of deficiencialism in academic writings made it not too surprising, to observe a dearth of documented evidences of teaching practices that addressed the question of disability from a perspective of equity and social justice. Also, as [Lambert and Tan \(2016\)](#) observed, there was a “divide between research in mathematics education and special education using Disability Studies in Mathematics Education” (p. 1057). However, there were exceptions, notably in the writings of, for example, [Healy and Fernandes \(2011\)](#), who argued against discourses that equate difference with disadvantage, and demonstrated that the only difference between sighted and blind learners lay in the tools by which each group experiences the world. [Nardi et al. \(2018\)](#) called for a broader understanding of teaching mathematics in which the learner is involved in sharing the feelings of the teacher about certain phenomena while the teacher strives to feel the mathematics of the student. [Healy and Powell \(2013\)](#) highlighted the challenge of attaining equity in mathematics education within societies marred by inequalities, considering how identities, including disability are ultimately constructed along with social, political and economic processes.

A sociopolitical understanding of disability highlighted the necessity for a critical approach to teaching mathematics to blind children. And the idea of carrying out this project raised many questions and challenges. One of the many challenges was a dearth of research in mathematics education that addressed the question of disability from a perspective of equity, social justice, oppression, resistance or empowerment. [Skovsmose](#)

(2016) has mentioned that he could hardly find any study that explicitly referred to mathematics education for social justice in a context involving blind students. He then asked the question, “What could reading and writing the world with mathematics mean for blind students?” Skovsmose recognized that doing so would be a challenge for blind students, for among other reasons, due to “difficulties that arise from the relationship between Braille and mathematical symbols.” However, I found some problems with the premise of these concerns. Firstly, the mathematics with which we may want blind children “to read and write the world” may serve to further reinforce their “otherness”. Secondly, the relationship between “Braille and mathematical symbols,” as Skovsmose speaks of, presented the view that there exists a “normal” way of writing mathematical symbols, and the “other” way, namely, Braille as done by blind children. Also, the dependence on “the available technology” constructs a blind child as a “potentially full human” rather than an already full human being to begin with.

Skovsmose (2014) argued that for mathematics education to work in support of democracy, “the microsociety of the mathematics classrooms must also show aspects of democracy” (p. 4). But this raised the question of what a democratic classroom can mean when it includes blind and mentally challenged children studying alongside, for example, students considered gifted, along with an “expert” teacher within a society where mathematics plays a political role while presenting itself as neutral.

To critique the supposed neutrality and universality of mathematics, I turned to Pais (2013a) who narrated his exploration into ethnomathematics, that, combined with critical mathematics education (CME) seemed to hold the potential to question the role of mathematics in the school curriculum, and mathematics itself as a culturally bounded field of knowledge. Ethnomathematics, Pais recollected, provided the “epistemological critique of the enduring belief in the universality and neutrality of mathematics knowledge” (p. 2). While disabled children do not constitute an ethnic group, they are indeed affected by the epistemological hegemony of mainstream mathematics for which a critique could have come from ethnomathematics. As Pais highlights, the importance of ethnomathematics is not so much related with the study of “other” mathematics but with “its critique of academic mathematics itself, through a social, historical, political and economic analysis of how mathematics has become what it is today” (Pais, 2013a).

However, as Pais then pointed out, in the classroom, ethnomathematics gets stripped off of its emancipatory core and is reduced to a learning device devoid of any critical reflection on the sociopolitical aspects of academic mathematics. Subsequently, when local knowledge is brought to school it gets decontextualized from the conditions that justify the emergence and use of this knowledge (Pais, 2013a,b; Knijnik, 2012). Pais dismissed the role of CME in providing a “solution for problems that by their very

nature are economic and political” and argues that “if the purpose is the high ideals of peace, democracy, social justice and equality, the route via mathematical thinking, ... is a dead end (p. 5).” However, it could be argued that Pais’ targeted his critiques at didactic practices based on how CME (including ethnomathematics) has so far been applied. However, CME necessitates “reinventions” of critical pedagogies in given contexts (Frankenstein, 1983). In the context of teaching mathematics to blind children, while locating disability as well as mathematics within the (socio) political and economic realm, the question that needs to be asked is, *How may Critical Mathematics Education be “reinvented” in view of taking a social and political economic approach towards teaching mathematics to blind children?* And simultaneously, CME could inform Disability Studies, considering the role of mathematics education in justifying exclusion and disablement.

1.2 Overview of thesis

The objective of the research study presented in this thesis is to address the question of what the social model of disability can mean in the context of teaching mathematics to blind students. By recognizing that the present condition of people with disabilities is not a natural and permanent feature of human society, the study questions, by taking a cue from Agostinone-Wilson (2013), “How did things get this way?” and “What are we going to do about it?” The “things” in the research study refers to the marginalized position of blind students. The “we” is invoked to highlight the fact that narrow individual solutions do not work for problems structured into a political economic system in which schools serve to exclude, marginalize and disable many groups of people from participating economically in society. In order to answer these two broad questions, the thesis is organized in the following manner.

This being the first chapter, by means of introduction presents a background of my study, the motivations and demotivations behind exploring the topic of disability in the context of mathematics education. Chapter 2 is titled **Review of Literature: Contending theories on Disability and Mathematics education**. It focuses on literature surrounding Disability theory and Mathematics Education. An emphasis is laid on the debates between a Marxist (social model) view on Disability and the largely postmodernist interpretations on disability that tend to reject the social model. The chapter also explores the different arguments and contestations within the field of research known as Critical Mathematics Education (CME). However the focus of the section on CME remains on the political economic dimension of mathematics education. In Chapter 3, **Research methodology**, I present my research methodology. The

research study was predominantly a Case Study but also contained aspects of Participant Observation, Participatory Research and Critical Ethnography. Chapter 4, **Study 1: On Inclusive learning**, contains the bulk of the data I collected from my field study. The chapter begins with two episodes of me tutoring students but largely focuses on two mathematics camps which we organized at the study centre. The tutoring episode highlighted the social dimension of disablement and enablement, and the potential of mathematization in helping create inclusive learning, which led to the hypothesis that a mathematics classroom need not be disabling for blind learners. The mathematics summer camps served to explore the question of developing an inclusive mathematics classroom using the critical insights gained from my interactions with the students, and from engaging with the social model of disability. The teaching sessions helped validate and refine my argument and provided valuable insights (like facilitating mathematization and collective behavior among students) for making classrooms inclusive and democratic (in terms of an equitable distribution of power among all participants). The second part of the study is presented in Chapter 5, **Study 2: Limits of Inclusion - Beyond the Classroom walls**, and presents the limits of the solutions offered in chapter 4. Here I begin by sharing my experience of accompanying a student from the centre for his entrance exam. Through presenting the stumbling blocks that we encountered in the course of his giving the exam, I demonstrate how they revealed certain (dialectical) contradictions of mathematics education under capitalism. To validate the claims I made with regard to the economic dimension of schooling and mathematics education that were revealed through that episode, and to further my understanding of the various issues that came to light, I took an interview of an ex-student of the centre who wished to pursue higher mathematics. The entrance exam episode and the interview illuminated the political economic dimension of exclusion in terms of how the presence of mathematics in entrance tests played an ideological role in facilitating exclusion by masking certain contradictions of Capitalism and the underlying economic processes that served to foreclose any possibility for students to realize their mathematical proficiency. In the 6th and final chapter, **Concluding analysis: So what does the social model of disability mean for mathematics education?** I summarize my research study. Through referring to how Capitalism has created a “social malconception” of mathematics education, the section attempts to offer possibilities for collectively developing a more humanist mathematics education, and a more equitable society.

Chapter 2

Review of Literature: Contending theories on Disability and Mathematics education

This chapter is dedicated to a review of literature on topics concerning mainly disability studies and mathematics education. I begin (Section 1) with an overview of the field of Disability Studies. I emphasize the debates between a Marxist view on Disability (mostly drawing from the “social model of disability”) and the largely postmodernist view on disability that seeks to move beyond the social model. I also explore the different perspectives on Critical Mathematics Education (CME). In order to foreground these writings within the sociopolitical milieu in which the research study was carried out, I include a section on literature on the history and politics of education in India.

2.1 On Disability Studies

Disability studies as a discipline rejects popular ‘deficit’ perceptions that equate disability with the physical or mental limitations of individuals. Disability studies provides an alternative framework through which disablement can be understood in terms of how social conditions *disable* people with impairments.

However, within disability studies, scholars disagree on some basic questions regarding how disability should be conceptualized, and problems related to disability should be responded to. It is important to engage critically with the contending perspectives on disability because each perspective is premised on certain assumptions. Consequently each perspective or model determines broadly:

1. How the phenomenon of disability is understood and presented.
2. How social phenomena that seem unrelated to disability are conceptualized.
3. The nature of research questions raised.
4. The solutions offered.
5. The limits of those solutions.

The limits of the solutions subsequently feed back into the perspective on disability and reinforces those limits as indubitable features of disablement. For example, from the perspective of the “individual model of disability” (which is rejected by Disability Studies), the source of disablement lies within the individual. The problems associated with disability are subsequently attributed to the individual having the presumed disability. The “social model of disability” that arose as an alternative framework to the individual and medical model of disability was originally theorized from a Marxist perspective by the Union of the Physically Impaired Against Segregation ([UPIAS, 1976](#)). This model located the current form of disablement, in the class structure of society and “the product of a mode of production under which one’s value is determined by their exploitability within the wage labor system” ([Jaffee, 2016](#), p. 1).

As opposed to the Marxist views on disability, a Postmodernist perspective that gained prominence in social theory in the 80s led to disability being theorized as a socio*cultural* phenomenon. Consequently, academic focus shifted from social structural causes of disablement to individual experiences of disability. Disability was argued to be constructed primarily through culturally embedded discourses and only reinforced through social practices and social structure. The main contention between Marxist and Postmodernist scholars of disability studies concerned the relationship between impairment and disability. For Marxist like [Oliver \(1996\)](#) and [Finkelstein \(1981\)](#), disability is fundamentally different from physical and mental impairment. However, for the postmodernists like [Shakespeare \(2014\)](#), “disability arises as a complex interaction of factors” and in reality, “people are disabled by society *and* by their bodies and minds” (p. 5).

The different positions within disability studies share a common rejection of “the individual model of disability” which “sees the problems that disabled people have as being a direct consequence of their disability ([Oliver, 1983](#), p. 15).” From an individual model view, the onus of adjustment is seen to lie within the affected individual. This proves to be “politically convenient” since “the failure of the welfare department to provide the right assistance can be ignored (p. 19).”

The individual model can be traced back to the era of enlightenment where society was modeled as a collection of autonomous, freely acting rational individuals. Disability was

also seen through an individualist perspective of society. Disabled people's problems were seen as being caused by deficiency, disease or disorder. Also referred to as the "medical model," the individual model is reflected in the *International Classification of Impairments, Disabilities and Handicaps* (ICIDH) document of the [World Health Organization \(1980\)](#) of the United Nations (UN). The ICIDH document which was developed in the 1970s was published as "as a tool for the classification of the consequences of disease (p. 1)." The ICIDH document differentiated disability from *disorder*, *impairment* and *handicap* but maintained the cause of disablement as an outcome of problems associated with the body. The ICIDH however acknowledged the social aspect of disablement in their definition of handicap but inasmuch as how it is dependent on "existing societal values, which, in turn, are influenced by the institutional arrangements of society."

The individual model which is often spoken as being synonymous with the medical model is a radical departure from the pre-enlightenment era before the rise and social acceptance of modern medicine. In the medieval "Dark ages" characterized in Europe by a dominance of Christianity and a feudal mode of production and social order, disability was predominantly perceived and officially considered as having supernatural causes and therefore being unamenable to human treatment. As Winzer put it, "If disabilities are imprinted before birth by God, the Devil, or nature, then they would not be amenable to amelioration except by miracle ([Winzer, 1993](#), p. 43)." However, such was not always the case, as [Slorach \(2016\)](#) (who discusses at length, how disabilities were dealt with in different historical periods) pointed out, "Contrary to myth, accidents at work were usually seen as natural (or man-made) and not divinely caused punishments and so were subject to human alleviation" (p. 53). Slorach traces the rise of disability as a form of oppression to late feudalism until which, "families often lived and worked as large extended groups, enabling greater networks of support for child-rearing and caring for the elderly. And for most people, there was no concept of literacy and intellectual ability" (p. 58). "The rural production process and the extended nature of feudal family . . . permitted many people with impairments to participate in daily economic life" (p. 61). Slorach refers to a population census of 1570s Norwich that found "a "lame" and one-handed 80 year old woman who worked by spinning and winding yarn and a blind man who worked as a baker" (p. 61). The introduction of farming technologies that led to surplus agricultural production led to merchant trading networks and the growth of towns that tied together previously isolated villages. Social networks also led to an exchange and spread of knowledge and inventions across different (non-Christian) civilizations, leading to condition favourable for reason and an undermining of the Catholic Church's authority over the minds of the people, and the rise of enlightenment. In addition, Europe witnessed a plague and peasant revolts, repressions, the weakening of the power of feudal lords with rural workers producing finished goods in their own

homes, the rise of industry and the development of new technologies like the clock that could measure worker productivity.

Accompanying the emancipatory ideas that arose during Enlightenment was also “the unequivocal declaration that something must be done for the weak, the dependent, the disabled - for all those who could not earn a living in competition with the fit” (Winzer, 1993, p. 77). Subsequently, the 18th and 19th century saw a rise in the number of institutions like special schools and asylums.

With the development of modern medicine, the rise of special education and the subsequent classification of disabled people based on their particular disabilities arose the medicalization (i.e. the medical model) of disability. The medical model provided a justification for the expansion of institutional facilities to serve the needs of exceptional students. Under such a medical model, the source of problems of learning, behaviour, and socialization were seen to be located within the individual. Such problems then justified special schooling and school failure.

2.1.1 The Social Model of Disability

The social model of disability was developed as a response to the prevalence of individualizing explanations for the problems faced by people with disabilities. By highlighting how social structures disable people and thus redefining the meaning of disability, the social model shifted the onus of adjustment from the disabled individual to the disabling society. As Slorach (2016) and Jaffee (2016) discussed, the ideas underlying the social model of disability were first expressed by a group of disabled socialists who called themselves the Union of the Physically Impaired Against Segregation (UPIAS). The UPIAS declared in their *Fundamental Principles of Disability* document that,

it is society which disables physically impaired people. Disability is something imposed on top of our impairments, by the way we are unnecessarily isolated and excluded from full participation in society. Disabled people are therefore an oppressed group in society (UPIAS, 1976, p. 4).

The social model received tremendous support from various disability rights activists and proved to be emancipatory to disabled individuals as well. Egan (2012), an advocate of the social model, expressed her problem with the phrase ‘person with a disability’ and the notion of ‘having a disability’ by lamenting, “. . . I am disabled by a society that places social, attitudinal and architectural barriers in my way. This world we live in disables me by treating me like a second-class citizen because I have a few impairments

- most obviously a mobility impairment.” Locating the “the difference between “having a disability” and “being disabled” within the individual and social model respectively, Egan highlighted, that the individual model presents

the idea that a person is prevented from functioning in our society by their body or brain and it’s just that person’s tough luck. If they can’t blend into this world, it’s not the world’s problem. The social model is . . . the idea that a person with an impairment or illness is disabled by the society we live in because of all the barriers that are put in our way.

Social modelists’ advocate the term “disabled person” as opposed to “person with a disability” since the term recognizes that people are *disabled* social structures within which we are all embedded. The latter term presupposes disability as a thing existing independent of the form of society.

Philosophically, the social model is underpinned by a dialectical conception of society and regards the whole to be greater than the sum of it’s parts. An expression of a dialectical conception of society is well reflected by [Lewontin and Levins \(2007\)](#), who stated that, “No human being can fly by flapping his or her arms, nor could a crowd of people fly by the collective action of all flapping together. Yet we do fly as a consequence of social phenomena” (p. 37). By locating the individual in a dialectical relation with society, the social model strives for the development of a society which would negate individualism and promote “genuine individuality, cultivating rounded human growth in place of a one-sided and fragmented development of skills” ([Slorach, 2016](#), p. 270).

2.2 Social model vs Human rights model

While disability studies scholars in general advocate a social perspective towards disability, they differ with regard to what a social model implies. For [Shearer \(1981\)](#), the social model called for society to remove socially disabling barriers. This view was shared by what came to be referred to as the “Human rights model” (For example, see [Jackson \(2018\)](#)) that was taken up by the UN Convention on the Rights of Persons with Disabilities (UNCRPD). The UNCRPD committed to protect full rights of disabled people to access healthcare, education, employment, etc. In contrast, the UPIAS view of disability as developed and advocated by authors like [Oliver and Barnes \(2012\)](#), [Finkelstein \(1981\)](#), etc. recognize barriers as arising out of a social system whose defining characteristic is its mode of production. With regard to, for example, the right to employment, the Human Rights model takes availability of jobs for granted.

However, as Helen Keller (1920) had communicated in 1912, “We have been accustomed to regard the unemployed deaf and blind as victims of their infirmities. That is to say, we have supposed that if their sight and hearing were miraculously restored, they would find work” (p. 242). The Human Rights model thus effectively seeks to achieve human rights (for example, the right to an employment) within capitalism overlooking the fact that Capitalism needs to create a vast reserve of labour in order to keep wages low and profits high. Capitalism engenders gross human rights violations with each discovery of profitable investment opportunities in the form of oil and metallic reserves in third world countries whose governments don’t act as comprador leaders. The UPIAS view of social model being premised on a Marxist conception of human society considers it paramount to think about an alternative to capitalism. This model also recognizes class struggle as an inherent feature of class society, and its historical contribution in bringing about radical social change and improving living conditions for the once oppressed. The social modelists thus argue that disablement, which is a structural problem and inextricably linked with the political economy, can only be removed by disabled people engaged in collective political struggles (Oliver, 1983).

2.2.1 The Postmodern turn in disability studies

The political changes in 1980s and 1990s, as Agostinone-Wilson (2013) highlighted, saw the rejection of Marx in academia and the acceptance of “false pragmatism/ postmodernism, alongside the growth of right-wing and reactionary ideologies” (p. 7). In the field of Disability Studies too, “the politically centre right in the disability movement” gained prominence and called for the social model to be “updated” so as to shift the focus back to changing attitudes, accepting diversity, and attaining legal rights as ends in themselves (as discussed by Finkelstein (2007)). The postmodern turn objected to the social model and proposed that disability be theorized as a *sociocultural* phenomenon (that ignored the political economic dimension of disability by emphasizing its sociocultural outcomes) in which disability experiences are perceived to be constructed primarily through culturally embedded discourses and only reinforced through social practices and social structure (for example, see Corker (1998)). The postmodernists accused the social model for creating a rigid binary between impairment and disability, thereby devaluing “individual embodied experience” (Ahmed and Chao, 2018, p. 175). Shakespeare (2014) advocated what he referred to as his “interactional approach” which conceptualized disability as “an interaction between individual and structural factors.” Chappell (1998) criticized the social model for almost entirely ignoring learning difficulty.

However, as Oliver (1996) pointed out in his earlier work, the social model is not to be taken as a reified thing and applied in a rigid or prescriptionary manner, but rather, as

an alternative to the individual model, so as to raise a different set of research questions (Oliver and Barnes, 2012, p. 23). Also, to emphasize the social dimension of disability and demarcate it from the biological is not to deny the latter.

Shakespeare's 'interactional' approach explained disability in terms of individual pathology and "associated functional limitations and culturally determined deficits (Oliver and Barnes, 2012, p. 11)" thereby suggesting that disabled people (and their "burdened" caretakers) irrespective of their class location have and will always face the kinds of disadvantage they experience under capitalism (Slorach, 2016) irrespective of how society is organized. Further, as Oliver and Barnes (2012) argued, the medicalizing of disability effectively served to reproduce sociopolitical and economic structures by locating the solution to the disability problem within professionals who address the supposed inadequacies of disabled people.

Through invoking the autonomous individual, postmodernism attributes ableism to the ideology of individualism that characterizes modernity. And from a post-modernist perspective, they attribute disability to the culture of society denounces those who deviate from the "ideal" human form, and the way to 'fix' disablement is to change this culture through changing beliefs and attitudes that others hold about disablement. Firstly, this is an idealist way of thinking because it is based on the assumption that attitudes are more basic than material social reality, and material social reality can be changed by changing attitudes. And secondly, to attribute the root cause of a problem in the mindset of society renders futile any attempt at mitigating the problem since we have hardly any access to the mindset of society. And thirdly, by ignoring the role of collective democratic struggles in bringing about equitable social changes, the concept of ableism theorized from a postmodernist framework proves to not depart adequately from individualism and ends up reinforcing the very theorization of society it claims to reject - that society is ultimately made up of free rational individuals, and the problems of society can be fixed by changing the mindset of individuals so that they behave more rationally and learn to respect variation and difference within human society.

According to a more materialist way of thinking, beliefs and attitudes of individuals, and even irrational social practices arise not only from the physical body but more importantly, from the material structure of society in which individuals are embedded. And so it regards that solutions to social problems must be systemic and structural.

Those who may agree that visuonormativity in mathematics is a form of ableism and a social problem may not readily critique research claims that advocate visual ways of teaching. In the field of education and cognition, it is not unusual to find statements that rationalize the claim that blind children also "visualize." Arcavi (2003) argues how "Vision is central to our biological and socio-cultural being." and locates the experiences

of even blind people as a visual experience by stating that “visualization may go far beyond the unimpaired (physiological) sense of vision.” Making vision central to learning mathematics, he states as though it is a good thing that, “the centrality of visualization in learning and doing mathematics” has become “widely acknowledged”. Arcavi describes visualization as a key component of “reasoning, problem solving, and even proving.” Arcavi’s work adds further support to the understanding that “mathematics . . . relies heavily (possibly much more than mathematicians would be willing to admit) on visualization in its different forms and at different levels (p. 216-217).” On the one hand, such a statement appears hopeful considering that it tells us that blindness need not hamper visual reasoning. And therefore we need not worry about reconsidering how we define mathematics education so as to maintain its universal character. But on the other hand, Arcavi ends up creating a new kind of normativity that involves visualizing rather than seeing. The problem with this new normativity is that, just like how not all people have vision, similarly, not all people can visualize. For example, the BBC news article by [Gallagher \(2019\)](#) that reported the case of two individuals, Ed Catmull and Glen Keane who had the condition called Aphantasia, which is characterized by the inability to generate mental images ([Zeman et al., 2015](#)). However, the impairments did not stop Ed from becoming chief of Pixar who developed a method of animating curved 3D surfaces, and Glen from creating the cartoon character named Ariel (from *The Little Mermaid*). It is therefore problematic to assume that all children visualize. Because problems related to the visualizing of mathematical ideas would continue to be located within the student, and reinforce the idea that a student’s failure and exclusion is their own individual problem, an outcome of their infirmities or lack of hard work rather than a social problem, a central feature of the schooling process under capitalism.

The concept of ableism is often cited by mathematics educators who argue for shifting focus away from the presumed disabilities of individual students and towards ways in which social environments and beliefs about difference exclude disabled students from learning mathematics. Using the notion of Ableism, [Borgioli \(2008\)](#) refers to individual and medical models of disability as a “modernism view” and contrasts it with, and advocates, the postmodernism view that explains disability as a social construction based on “incorrect, immoral assumptions regarding difference (p. 134).” Implicit in the postmodernist view of disability is the idealist corollary that, the problem of disability related problems can be rectified through changing ideas and assumptions regarding difference. Borgioli advocates a postmodernist view of disability as opposed to the individual and medical view but does not consider the social model view which sees disablement as structural and linked to the economics of the disabling institution.

Nevertheless Borgioli does illuminate how ableism operates in mathematics education in the context of special education, for example, when teachers are recommended to

“uncomplicate” mathematics for disabled children which reinforces the idea that certain students are incapable of, and need not participate in activities that involve mathematical inquiry, etc. [Hehir \(2002\)](#) from a similar standpoint argues that the root cause of inequalities stems from assumptions about what it means to “walk, talk, paint read or write (p. 35).” To this [Borgioli \(2008\)](#) adds that there is also more than one way to ‘do mathematics.’ The concept of ableism from a postmodern standpoint does not, however, address the question of why mathematics education took on the particular form in which all students are expected to do mathematics in one way. Neither does it address the individualization of students. Among the most cited definitions of Ableism, the political economy of Capitalism remain largely ignored and the problem of disablement is reduced to a form of discrimination against disabled people. For example, Hehir refers to ableism as “deeply held negative attitudes towards disability analogous to racism (p. 10).” While there are similarities between ableism and racism, simplistically comparing the two ignores the political and economic history of human society that gave rise to racism (and ableism), and the material factors that impose racism, and disabling conditions in society and learning environments. Hehir reduces racism to merely the discrimination of people of colour. From such a standpoint, an answer to the question of “discrimination” takes the form of a call to change our beliefs and make our (Capitalist) society and its institutions more inclusive to the needs of all individuals irrespective of class, race, caste, gender and disability.

However, from a Marxist perspective, we see that ‘ableist biases are derivative of the social relations of production thus evincing that remedying the oppression of disability is not possible within a capitalist economy ([Jaffee, 2016](#); [Russell, 2011](#)). Ableism is ideological and a reflection of certain material economic conditions, and its materiality lies primarily in practice, in material objects, rather than merely ideas and mindsets. Also, there are material interests involved in a political economy that engenders a schooling system that’s designed to fail, and thus produce ableist justifications for the marginalization of, a vast number of people.

In a way, theories about disability can be categorised on the basis of whether they are more materialist or more idealist. This distinction is based not just on whether they are more concerned with material or cultural forces, but whether material or cultural forces are taken to be more basic with regard to causes and effects. In this regard, [Priestley \(1998\)](#) groups various theories of disability under two sets of categories Idealist/Materialist and Individual/Social. My perspective falls in the category of what Priestly categorizes as Realist Materialist which sees social relations being derivative of “the development of a mode of production within a specific historical context (p. 78).”

The dominant discourse on disability and exclusion plays an ideological role in concealing questions that although will not be addressed in this thesis need to be taken into consideration. For example,

- Why are students with disabilities underrepresented in schools in the first place?
- Why aren't schools equipped to include students with disabilities? Is India too poor to provide such facilities?
- Is there a relationship between the budget cuts in education and the exclusion of blind children?
- Is there a relationship between the teacher-student ratio and exclusion of blind children?
- Is there a relationship between the prevalence of high stakes tests and disablement? Who are the powerful stakeholders that benefit most from such an industry?
- Why are special education teachers forced to develop “low cost” teaching tools for their blind students in a country whose public sector banks can afford to waive off loans of its defaulting capitalists to the tune of tens of billions of dollars?

From a social model lens we also see that mathematics education itself plays a central role in sociopolitical processes (Skovsmose and Borba, 2004) by, for example, providing means and justifications for certain forms of inclusion and exclusion (Skovsmose, 2005). Further, as Pais (2014) points out, failing students is a necessary feature of a schooling system that is actively involved in social stratification. In a similar way, Burris (1988) highlights through the concept of reification, that although schools function as “a social process of selection for an already stratified social order,” they take the reified appearance of an institution aimed at providing productive skills. Subsequently, “Poverty and inequality, . . . appear as the consequence of personal deficiencies in the capacity to acquire technical skills, rather than the normal outgrowth of capitalist economic institutions.” And this appearance “lays the foundation for the meritocratic legitimation of class inequality (p. 17).” Although Pais and Burris do not talk specifically about disability, they highlight how schools need to produce a few students who excel and many students who fail. This gives rise to a *fetishism* of “ability” and “disability”, i.e. “ability” and “disability” appear as an inherent property of a student rather than a historically specific way of predicting the potential of an individual to carry out certain kinds of socially necessary labour within that society.

The question of equity is therefore not exclusive to people who are disadvantaged owing to their race, socio-economic position, gender, etc. but pertains to the structure of the

schooling system, that affects society as a whole. The exclusivist and disabling character of schools is not contingent upon the physical impairments of individuals.

Although Postmodernists claim to offer an alternative to individual models of disability, just as with the medical model they seem to hold the assumption that if the students in question were not disabled, they would not face a problem.

2.3 On critical mathematics education

Analogous to the how the social model questions taken-for-granted assumptions about disability, Critical Mathematics Education (CME) questions what is popularly taken for granted as mathematics education. CME and the social model of disability share a common feature of trying to understand society as a whole, while locating the particular object of analysis (disablement or mathematics education) as existing in a dialectical relationship with society. CME as a sub-field of research in mathematics education arose out of the recognition of the importance of taking into account the socio political, cultural and economic dimension of mathematics education. The development of CME was influenced by Critical theory as conceptualized by the Frankfurt School and the radical pedagogy of Paulo Freire.

CME was born out of a shift from predominantly positivist and cognitive research (that focused on the mathematics learning of individual children) to a focus on the social aspects of learning (that inquired into for example, the forms of power manifested in social interactions among learners). In addition to the social turn, mathematics education also witnessed a sociopolitical turn with a growing number of mathematics education researches taking into account the fact that, as [Gutiérrez \(2013\)](#) stated, “mathematics is a human practice means it is inherently political, rife with issues of domination and power, just like any other human practice”.

2.4 Vygotsky and social learning

The social model of disability laid the foundation for the field of disability studies that in turn impacted allied disciplines including mathematics education. The field of disability studies significantly influenced special education that was otherwise dominated by individual and medical models of disability and also added a further impetus to learning interventions based on the works of Vygotsky, who in the early 20th century (over 50 years before the establishment of Disability Studies as a discipline) differentiated the biological from the social dimension of disability. [Vygotsky \(1925\)](#) stated that: “It

goes without saying that blindness and deafness are biological facts and not at all of a social nature, but the teacher has to deal not so much with these facts as with the social consequences of these facts. When we have a blind child as an object of education before us, we are compelled to deal not so much with blindness in itself, as with the conflicts which arise therefrom within the child when it enters life. . . . Blindness or deafness, as a psychological fact, is not at all a misfortune, but, as a social fact, it becomes such” (p. 228). Vygotsky’s emphasis on the social learning of children with special needs proved influential in the mathematics education research community with educators adopting his sociopsychological approach to teaching mathematics to blind children (notable examples include the works of [Radford \(2013\)](#); [Healy and Fernandes \(2011\)](#); [Fernandes and Healy \(2013\)](#)).

However, while a substantial amount of research work may be found in the field of special needs education, and some significant work that uses the lens of Ableism, one finds a dearth of empirical research that addresses the political economic dimension of disability or looks at disability as a social justice concern while addressing the question of teaching mathematics to blind children. In fact, disability itself is underrepresented in mathematics education in the larger research community ([Tan and Kastberg, 2017](#)).

In the context of mathematics education, perspectives other than the dialectical and historical materialist Social Model and Postmodernism have been used to address the social dimension of disability related issues through the route of mathematics education. For example [Marcone \(2015\)](#) critiques deficiency perspectives about disability from a poststructuralist perspective through the notion of what he calls as *deficiencialism* which refers to *deficiency* as a construction of *normality* ([Skovsmose, 2016](#), p. 3). [Figueiras et al. \(2016\)](#) have critiqued the very notion of inclusion for taking for granted “the order of things” into which students are expected to be included/ integrated. However, in this paper, I use the social model of disability as a framework owing to it taking into account the political economic dimension of disablement, and therefore proving to be a useful model for exploring the question of exclusion.

2.5 Economy, Schooling & Disablement

Through a political economic lens, various scholars have observed the antagonistic relationship between social justice and schooling under capitalism. They have however expressed differing perspectives on the role of schooling and education. On the one hand, for authors like Michael Parenti, Louis Althusser, [Bowles and Gintis \(1976\)](#), schools are essentially sites of reproduction of the dominant sociopolitical and economic order. On the other hand, Giroux, Connell, et al. argue that education, and by extension, schooling

is about liberation and involves “equipping people with the knowledge and skills and concepts relevant to remaking a dangerous and disordered world (Connell et al., 1982, cf. Giroux, 2001, p. 114).” Agreeing with this perspective, Giroux (2001) expresses his concern about the gap between the “promise” and the “reality” of schooling. However, as Parenti (1999) pointed out schools indeed fulfill their purpose:

To say that schools fail to produce an informed, critically minded, democratic citizenry is to overlook the fact that schools were never intended for that purpose. Their mission is to turn out loyal subjects who do not challenge the existing corporate-dominated social order. . . . The educational system is both a purveyor of the dominant political culture and a product of it (p. 22).

The school is also, as Louis Althusser explains, an ideological apparatus of the State. The ideological feature of schooling lies in the way it disseminates normative practices and ideas to students not by explicitly stating those ideas but rather, by taking for granted those ideas and practices (for example, an uncritical obedience to authority) as a premise behind whatever may be stated. Subsequently, as Althusser (2006) points out, by producing an obedient workforce (read: labour power), schools contribute to the reproduction of the conditions necessary for a Capitalist mode of production:

. . . [students] also learn the ‘rules’ of good behaviour, i.e. the attitude that should be observed by every agent in the division of labour, according to the job he is ‘destined’ for: rules of morality, civic and professional conscience, which actually means rules for respect for the socio-technical division of labour and ultimately the rules of the order established by class domination. . . . the school (but also other State institutions like the Church, or other apparatuses like the Army) teaches ‘know-how’, but in forms which ensure *subjection to the ruling ideology* or the mastery of its ‘practice’. (p. 89)

Bowles and Gintis (1976) point out how, “the educational system mirrors the growing contradictions of the larger society, most dramatically in the disappointing results of reform efforts” (p. 5). Bowles and Gintis dismiss the advocates of “liberal social reform” by stating that they “mouth old truths and trot out tired formulas for social betterment in the vain hope that the past decade has been a quirk, a perverse and incomprehensible tangle in the history of progress which will - equally incomprehensibly - shake itself out” (p. 7). Bowles and Gintis point out how through the use of meritocratic means, schools legitimize inequality by allotting students, or rather a workforce in distinct positions within an occupational hierarchy. Schools therefore,

create and reinforce patterns of social class, racial and sexual identification among students which allow them to relate “properly” to their eventual standing in the hierarchy of authority and status in the production process. Schools foster types of personal development compatible with the relationships of dominance and subordination in the economic sphere, and finally, schools create surpluses of skilled labor sufficiently extensive to render effective the prime weapon of the employer in disciplining labor... (p. 11)

In a similar vein from a standpoint of special education, [Skrtic \(2005\)](#) offers a critique of the political economy of learning disabilities by highlighting how schools, being bureaucracies function as “performance organizations, standardized, non-adaptable structures that must screen out diversity by forcing students with unconventional needs out of the system. And because they are public bureaucracies charged with serving all students, special education emerges as a legitimating device, an institutional practice that, in effect, shifts the blame for school failure to students through medicalizing and objectifying discourses, while reducing the uncertainty of student diversity by containing it through exclusionary practices” (p. 148-149).

Giroux disagrees with Althusser and Bowles and Gintis by arguing that they “fail either to define hegemony in terms that posit a dialectical relationship among power, ideology, and resistance, or to provide a framework for the developing of a more viable mode of radical pedagogy.” according to Giroux, Althusser, Bowles and Gintis, “relegate human agency to a passive model of socialization and overemphasize domination while ignoring contradictions and forms of resistance that also characterize social sites like schools and the workplace” and thus function to “mystify rather than explain how people resist, escape, or change the “crushing” weight of the existing social order” (p. 86).

The nature of the differing positions with regard to the place of schooling within capitalism are also found in the context of mathematics education. For mathematics education researchers like [Lundin \(2012\)](#), [Pais \(2014\)](#), the “gap” between the promise and the reality of schooling is an “inherent property of mathematics education itself” ([Lundin, 2012](#), p. 73). [Pais and Valero \(2012\)](#) argue that mathematics in fact contributes to the “*de-politicisation* of issues of equity, social justice, economy and, ultimately, politics itself” (p. 19). [Pais \(2014\)](#) highlights from a perspective of the economic role played by the school, how failure “is an all-encompassing reality permeating the whole of schooling” and a “*necessary* feature” of the same system that strives to achieve the goal of “education for all” (p. 1086). [Gutstein \(2012\)](#) on the contrary prefers to look upon mathematics education “as a weapon in the struggle.”

From a dialectical perspective, we see that disablement is one among many symptoms of the political economy of Capitalism under which, schools serve entrenched interests. When schools operate, as Parenti (1999) puts it, “in order to better secure cultural orthodoxy and politico-economic hegemony”, the outcome results in the production of “Bored, uninformed students” as merely a symptom, “a small price to pay (p. 26).” In a similar vein, Jaffee (2016) shows how schools function to reproduce the social relations of production which are “inherently disabling for those whose bodies it renders insufficiently exploitable, . . . including disabled students . . . serves to reproduce the conditions of their disablement (p. 5).” In other words the primary role of schools as an ideological machinery of the State, produces bored, uninformed and disabled children.

To recognize the political economic aspect of a school is not to relegate teachers to a passive role in carrying out the job they are assigned by a schooling system that in one way or the other is controlled by state and market forces. Just as the various State institutions such as the Church, the Army or the prison system which although built for specific purposes have also been used as spaces where ruling class interests have been subverted, schools too have proven to be useful as a site for subversion. “Fortunately”, as Helen Keller (1920) pointed out, “education does not depend upon educational institutions any more than religion depends on churches” (p. 46). And also schools need not succeed in serving as a barrier to emancipatory learning. As Giroux emphasized, schools contain “ideological and material spaces for the development of radical pedagogies (p. 116).”

Bringing a Marxist perspective to understand particular instances of disablement and resistance in a local context within India is certainly not a straightforward task involving merely reducing disability to a political economic category, but rather a dialectical process of engaging with theory through the lens of experience and retroactively reconceptualizing what was experienced in view of having grasped that theory. I present the experiences of my involvement with the mathematics learning of my (blind) students through a Marxist lens which was developed based on those experiences. I focus on the stumbling blocks that I encountered so as to present the contradictions they revealed. By “contradiction”, I do not mean it in the formal or Aristotelian sense but rather from the Marxist (or Hegelian) sense in which opposing forces coexist within a particular entity - forces that although remaining latent, often reveal themselves and become obvious during a crisis (Harvey, 2014) or difficult situations (D’Souza, 2018). While certain contradictions could be overcome through innovative pedagogical strategies, others were revealed to be an outcome of structural aspects of schooling, and pointed towards a limit to what can be achieved through inclusive teaching.

Chapter 3

Research methodology

The social model of disability sheds light on the fact that the problem of teaching mathematics to blind children who are essentially a socially excluded group of students, is more of a political than a pedagogical problem. It thus has implications for disability theory as well as mathematics education. [Oliver \(1997\)](#) argued that, “Disability cannot be abstracted from the social world which produces it; it does not exist outside the social structures in which it is located and independent of the meanings given to it” (p. 101). However, social research on disability has been dominated by frameworks underpinned by medical and individual ideologies that limited themselves to “classify, clarify, map and measure” the different dimensions of disabilities ([Oliver, 1997](#)). The dominant research paradigm within which disability research has typically been carried out has been from a positivist framework in which the researcher and the “researched” are both alienated, which as Oliver argued is “symptomatic of a wider crisis” between disabled people and the research community which in turn is a subset of a wider “research crisis” (p. 105). Oliver argued for an “emancipatory paradigm” that aimed at “confronting social oppression at whatever levels it occurs” and recognizing and confronting “power which structures the social relations of research production” (p. 110).

In keeping with the concerns of the research problem, my research method borrowed from the work of [Agostinone-Wilson \(2013\)](#) who illustrated what she called *Dialectical research*. Agostinone-Wilson states that dialectical research addresses two primary questions: “How did things get this way?” and “What are we going to do about it?” Agostinone-Wilson clarifies the meanings of the words that she used by saying that:

“Things” can refer to a wide range of phenomena, from the use of standardized testing to the unpaid labour of women. “Get” because the way things are is not natural or enduring; things become the way they are through

a combination of historical forces, under the constant shadow of capitalist social relations. “We” is deliberately invoked because individual, narrow solutions do not work for the kinds of things we are now facing, ... (p. 6)

3.1 Research Methodology

The theoretical grounding of the research design was based on the social model of disability as conceptualized by Michael Oliver, Vic Finkelstein, Roddy Slorach and Laura Jaffe, and critical mathematics education (CME) as articulated by Ole Skovsmose and Alexandre Pais. The broad goal of my research study was to explore the question of what the social model of disability could mean for critical mathematics education through a case study of the study centre for blind children in Mumbai. The research methodology was therefore a Case Study.

However, given the particular nature of the research, the study drew from Participatory Research method in which, as [Cohen et al. \(2011\)](#) described, the researcher does “research *with* people ... rather than doing research *to* or *for* people” (p. 37). The research study also involved Participant Observation which [Bogdan \(1973\)](#) described as being “characterized by a prolonged period of contact with subjects in the place in which they normally spend their time” and based on the recognition that “the only way to understand the complexity of social life is to immerse oneself in it (p. 303).”

3.2 On Case Study Research

[Adelman et al. \(1976\)](#) describe case study research as involving “the study of an instance in action” although the ‘instance’ contains the relationship with the ‘class’ from which it is drawn. As Adelman, et al. discuss, case study research can be set up in two ways. In the first, the hypothesis is defined and the researcher draws an instance or “case” from a general “class”. The researcher subsequently reveals some features of the case in order to make a generalization of the class. The research study presented in this thesis concerns the second kind of case study research in which the case is given, and within such a “bounded system” issues are studied in order to understand the class. This is not to say that the study stays within the boundaries of the system. For example,

We cannot answer questions about the effects of [an] innovation without reference to the history of the school, local authority politics, or the self-images and career aspirations of the teachers. Each case turns out profoundly embedded in its real world situation. (p. 142)

To understand case study research, it helps to demarcate it from other research methodologies. For example, case study is different from an experiment although the case study may include experiments as part of the study. As opposed to an experiment, a case study does not isolate a phenomena from the context. Yin (2009) describes case study as, "...an empirical inquiry that investigates a contemporary phenomenon in depth and within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident" (p. 18). And since phenomena and context are inextricably linked, Case study research involves coping with the "technically distinctive situation in which there will be many more variables of interest than data points" and as a result, "relies on multiple sources of evidence, with data needing to converge in a triangulating fashion" and as another result, case study inquiry "benefits from the prior development of theoretical propositions to guide data collection and analysis" (p. 18).

3.3 Limitations of case study research

A significant limitation of Case study research lies in the fact that, as Adelman et al. point out, the researcher "will be party to many inside stories not all of which will be negotiable currency in discussions outside the group under study. [The researchers] know more than [they] should tell [since] *others* must live with the consequences of [the researcher's] findings" (p. 146). Adelman et al. thus suggest "anonymisation" of reporting as a way of handling such problems. While anonymisation is limited in its scope in that it serves, as Agostinone-Wilson put it, "to never offend prominent stakeholders", it is still a price worth paying. Because firstly, case study research is about generalization of an issue, rather than the case. Secondly, anonymisation protects the relatively powerless participants from the relatively powerful stakeholders of the problem under investigation. As the intended audience of my research study carried are predominantly "outsiders", namely the mathematics education research community, I found it as a best bet to opt for anonymisation.

My research design also include aspects of research methodologies such as Critical Ethnography (Anderson, 1989; Trueba, 1999), Participant Observation (Bogdan, 1973) and Participatory Research (Cohen et al., 2011). Through the use of Participant Observation, I explored and analysed my teaching and interactions with students from the study centre in order to develop some insight into the question of teaching mathematics to blind children from a social model perspective.

3.4 Theoretical Perspective

The research method was developed with the help of the social model of disability which was underpinned by the understanding that the current form exclusion and disablement are outcomes the underlying contradictions of a capitalist mode of production. And identifying these contradictions are crucial to forwarding the cause of creating an equitable and non-disabling society. The study also aimed at identifying the various forms of resistance to ableism that were exercised by the people who are in one way or another oppressed by the disabling economy of Capitalism.

In view of a social model perspective on disablement, the following responsibilities of the mathematics education researcher come to the fore.

1. The researcher must be cognizant of situations that reveal contradictions underlying disabling processes in mathematics education, and what these contradictions reveal about the nature of mathematics education and schooling, and how these contradictions may be handled.
2. The researcher must address social relations and processes of exclusion and disablement that take the form of reified objects.
3. The researcher must recognize that resistance against oppressive forces has been an inextricable part of the history of class society that cannot be overlooked while attempting to develop a meaningful understanding of human society. The researcher must therefore identify and support the various forms of resistance within the lived domain of the participants, keeping in mind how oppression is entrenched within the schooling system.
4. The researcher must explore how problems concerning alienation, exclusion and disablement can be addressed at various levels including pedagogy.

3.5 Research Objectives (While beginning the study)

The broad objective of the research was to explore the implications of the social model of disability for mathematics education through a case study of the study centre for blind children. This exploration involved developing my understanding of disability by, among other ways, interacting with the students of the study centre, volunteering to help them during their exams, conducting sessions on mathematics, etc. Some specific aims of my exploration were as follows:

1. To understand which aspects of mathematics are visual (including those that depend upon visual processing), spatial, purely symbolic, discursive, etc.
2. To understand the political economic dimension of disablement and exclusion of blind students.
3. To develop a critical perspective on the social model of disability through interaction with the students.

The research study aimed at informing pedagogical practice as well as philosophy and politics. While beginning my study, my primary concern was to address, what I referred to as a “visual hegemony” in mathematics education. I also saw the visual aspect as a form of cultural politics. As the study progressed, I realized that the dominance of the visual in mathematics education was largely a symptom of a larger problem concerning the political economic role played by the schooling process. Nonetheless, the research also demonstrated that pedagogy could certainly contribute to addressing the problem. The research objectives concerning practice included the following:

1. Develop a pedagogy of mathematics, through critical dialogue with students, that challenges the dominant method of teaching mathematics, which presents it as inherently visual.
2. Deuniversalize dominant mathematics and uncover the cultural politics within it.
3. Theorize about how the developed pedagogy contributes to challenging the visual hegemony in mathematics education.

3.6 Research Questions

My concern on addressing the visual hegemony in mathematics education, along with finding potential in critical mathematics education led me to frame research questions that emphasized on the visual nature of mathematics. However, further engagement with the social model of disability, CME along with a deeper interaction with the students and teachers of the study centre forced me to broaden the scope of my questions. Further, keeping in mind the framework of “two primary questions” raised by [Agostinone-Wilson \(2013\)](#), the research questions that arose was broadly,

1. What are the underlying causes behind the exclusion and disablement of blind school students of mathematics?

2. What can we do about it at the level of pedagogy, curriculum and political struggle?

Systemic problems like the exclusion of blind people from the workforce and schooling is not merely a pedagogical or curriculum issue. However, pedagogy has a potential for creating conditions for radical social change that certainly cannot be overlooked. Also, only by encountering the limits of a pedagogical solution can we develop a more dialectical understanding of the bigger problem we are confronted with.

Since my initial concern was the dominance of the visual in mathematics education, and I found Freire's work insightful, I had initially raised the following questions.

1. How does the visual hegemony operate in mathematics education?
2. How does critical dialogue change perceptions of disability oppression and mathematics education among dialoguers?
3. What are students' perceptions about the causes of certain topics in mathematics being difficult?
4. What problems in mathematics are due to visual methods of teaching and defining mathematical concepts?
5. What teaching methodology would be best suited for developing a pedagogy in mathematics that could counter visual dominance in mathematics?
6. Would a shift from mathematics to (the process of) mathematization be effective in terms of learning, and liberation and empowerment?

The research study involved the following activities:

1. Designing a mathematics summer camp in the study centre in collaboration with the students.
2. Conducting and recording a discussion on a mathematics topic.
3. Recording informal conversations with students with their consent.
4. Analysing the recorded data with fellow researchers.
5. Discussing my observations with the students.
6. Following up with the students when they finish their schooling
7. Collating the various kinds of data to present the larger picture.

3.7 Research settings

My field work involved interactions with students of a study centre for blind children. The centre was located in an upper middle class locality. The centre aimed to provide educational support to partially/non-sighted students most of who attend regular schools. Some of the students did not attend any regular school but were preparing for their open schooling exams. Although 45 students were registered with the school, around fifteen attended regularly. Prior to beginning my field observations, my pilot study was carried out by interacting with these fifteen students. Every student had a different history with regard to their eyesight. Five students were congenitally blind. One lost her sight to glaucoma while another was losing sight to the same. The other students had either retinal or optic nerve related problems.

The instruments used for data collection depended upon the nature of the data collected. In this thesis, I present seven sets of data in Chapter 4 (within the classroom) and two sets of data in Chapter 5 (Beyond the walls of the classroom).

3.8 Corpus of Data

The corpus of data collected during the course of my study included the following:

1. Video recordings of teaching experiments conducted at the centre accompanied with hand-written notes.
2. Audio recordings of interactions with individual students while tutoring them for their school exams.
3. Audio recordings of interviews of students and teachers of the study centre.
4. Written notes of my reflections on experiences related to disability oppression.

Of all the data collected, I present only those specific episodes from my study that demonstrate the points argued in this thesis most effectively.

The first two sets of data as presented in Chapter 4, (in the sections titled, *Exploring the image of a cube* and *Comparing two schools*) was collected with the help an audio recorder. In each of these two settings, I was interacting alone with a student. In both scenarios, we were facing each other while I was reading from a textbook while the audio recorder was running.

The third set of data as presented in Chapter 4, (in the sections titled, *First maths camp*) was collected from a mathematics summer camp we organized at the study centre. Three researchers were involved in the study. We carried an audio recorder and notebooks to document our observations. In each session one researcher was assigned to note down observations. The fourth data set (Chapter 4, in the sections titled, *Second maths camp*) was conducted by me alone with an audio recorder.

The fifth data set (presented in Chapter 5, in the sections titled, *Beyond the walls of the classroom*) was noted largely from memory as the study was unplanned. However, to triangulate the data observations a sixth data set was gathered through the use of an open-ended interview of an ex-student of the study centre. I conducted the interview alone using an audio recorder and a notebook.

3.9 Sampling

LeCompte and Preissle (1993, as cited in [Cohen et al. \(2011\)](#)) elicit why ethnographic methods rule out statistical sampling; one of the reasons being that generalizability is not necessarily a goal of ethnography. They also enlist other forms of sampling, specifically: convenience sampling, critical case sampling, extreme case sampling, typical case sampling, unique case sampling, reputational case sampling, snow-ball sampling and explain in what context would each be appropriate.

Owing to the sensitive nature of the research, convenience sampling was used since I needed to work with only those students who wanted to visit the centre during vacations to participate in our maths camp sessions. The sample included also included the the mothers who accompanied the students. The second part of the study (as presented in Chapter 5) dealt more with “beyond the walls of the classroom” in which the study focused on an interaction with two students, one of who was part of the earlier study.

3.10 Ethical considerations

Taking the social dimension of disablement into account brings in additional ethical considerations for research in disability studies considering that in addition to the fact that the research participants are children of working class bahun parents, they are also socially and systemically excluded from mainstream schooling and society. The fact that the researcher came from a more socially privileged background added to the need for handling the research in a more sensitive manner lest the researcher add to the disempowerment of the participants.

However, handling a sensitive research topic by following all ethical protocols does not remove dilemmas from the mind of the researcher. For example, as [Cohen et al. \(2011\)](#) point out, “In interviewing students they may reveal sensitive matters about themselves, their family, their teachers, and the researcher will need to decide whether and how to act on this kind of information” (p. 170).

3.11 Access, consent and confidentiality

The gaining of access into the student community in the study centre evolved organically rather than formally owing to having been offered a fixed time slot and having developed a rapport with the students.

The research study as presented in chapter 4 was conducted through a discussion with the students, the parents who were present and the teachers and the manager of the study centre. With regard to the tutoring sessions, while the students (Faiz and Rina) requested that the lessons be recorded for their personal use, I took an informed consent of the students, the centre manager, the teachers and owner of the study centre to use the recordings for my research study. In addition to getting the informed consent of all participants, pseudonyms were used to refer to the participants in the study to ensure privacy and confidentiality.

The idea for the mathematics summer camp was given by the centre manager and the students who wanted to spend their vacations doing some learning activity at the centre. The mothers of the children were present while the sessions were carried out. Precautions were taken to ensure that the study was inclusive. I attempted to publish chapter 4 in an international journal prior to which I showed a draft to the study centre owners and the teachers who were involved in the study.

Addressing the ethical concerns with regard to the data in chapter 5 was more challenging as it contained sensitive information concerning the site of the research study. Precautions were thus taken to ensure that people spoken about were not identifiable. Also, the information hidden was not central to answering the research questions.

Broadly, the research was conducted at the study centre where the participants felt most at home. One interview with an ex-student of the centre (who I had known for six years, and was a college graduate at the time of the interview and wanted to visit my research centre) was conducted at HBCSE while she was accompanied by my colleague with whom she felt more comfortable.

Chapter 4

Study 1: On Inclusive learning

The research study presented in this thesis was carried out at a study centre for blind children in Mumbai, India. The centre catered to partially/non-sighted students most of who attended “normal” schools (with blackboards and teachers with no knowledge of Braille). A few students were not registered with any school and enrolled in the study centre to prepare for the tenth grade level examinations offered by the *National Institute of Open Schooling* (NIOS) ¹.

As of 2013, 45 students were registered with the centre. The number rose to 56 in 2019. The students were predominantly from working class and marginalized backgrounds. Prior to being a part of the study centre, most of the students studying here had been confined to their homes and were not even sent to any school. NAB sent teachers to their home who spent two hours a day, twice a week with them. As was pointed out by one of the NAB teachers Ms. Kanak (pseudonym) who taught at the centre, this was clearly insufficient given that in addition to the regular curriculum they also needed to be taught Braille, the use of an abacus, a tactile geometry kit, etc. In addition, the children had few opportunities to socialise with their friends or even their siblings who, as Kanak had mentioned, were afraid that they would get hurt while playing. Kanak narrated how she had to struggle with parents and school authorities so that the students could come to the centre and meet with each other rather than be isolated at their homes.

Our weekly visits to the study started in June 2013 and included an hour of music followed by a group activity mostly based on science or mathematics. As time progressed and rapport strengthened (more so owing to the informal nature of our interactions with

¹The NIOS which is an Open schooling system is an autonomous institution under the Ministry of Human Resource Development of the Government that offers course materials and conducts examinations. The NIOS offers a flexible model of giving subject-wise examinations while providing course material even in audio format thereby enabling students who might have dropped out from regular schools, to continue with their education.

them), our involvement with the students extended well beyond our roles as teachers. For example, among many other activities, we organized outings, trained the students for music performances during events and also volunteered to tutor during exams.

Our interactions also compelled us to think more deeply about certain fundamental aspects of mathematics which we otherwise took for granted. This helped me identify two aspects of mathematics learning that I found crucial and missing in mainstream teaching practices, namely, “mathematization” and “collective learning”. For example, on one occasion, I was asked to teach mathematics to Faiz. Faiz was in the 9th standard. In this grade, mathematics is split into Algebra and Geometry. Faiz wanted to revise his geometry. We began with chapter 1: Lines and Angles. The chapter began with Euclid’s postulates which was followed by axioms followed by definitions and solved examples. I used an audio recorder to record my teaching so that Faiz could listen to it on a later occasion. With Faiz’ permission, I shared the teaching incident that involved communicating textbook exercises based on diagrams made of straight lines.

The exercises involved identifying parallel and perpendicular lines in the diagram. This did not appear to be a crisis since we had at our disposal what are called as *Wikki Stix*TM, a set of sticky strings that could be stuck on a flat clean surface to make tactile shapes. Due to the *Wikki Stix*TM, exercises on parallel lines could easily be answered by making diagrams tactile ². Modifying my pedagogy to include the *Wikki Stix*TM seemed to have solved the problem. However the section that immediately followed was Parallel planes (Refer Figure 4.1). The image of Parallel planes in the textbook was drawn using straight line segments, which could certainly be drawn using the *Wikki Stix*TM. But “drawing” a tactile image on a 2D surface did not reveal it’s 3D structure. Being confronted with this problem made me realize that underlying the textbook’s representation of the figure of the parallel planes was the assumption that a student who “looks” at what appears to be two identical parallelograms with corresponding vertices connected, sees a cube.

The immediate solution to this problem was to use a 3 D block. But that would not really overcome the general question of being expected to possess a graspable version of any given abstract mathematical object. Also, at a more practical level, we did not have a cube shaped object with us. This contradiction demanded a innovative strategy to communicate 3 dimensional mathematical objects represented as 2 D shapes in a book, so as to answer questions related to it. Fortunately, along with teaching the subject matter I also happened to be engaging with the *Tower of Hanoi* puzzle at a personal level due

²Official information about *Wikki Stix*TM can be found here: <https://www.wikkistix.com/what-are-wikki-stix/>

Parallel Lines :

The lines in a plane which are not intersecting are called parallel lines. Parallel lines are always coplanar. We write line $l \parallel$ line m . (see fig. 1.13)

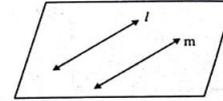


Fig. 1.13

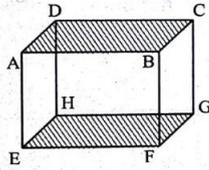


Fig. 1.14

Parallel planes :

Two non-intersecting planes are said to be parallel. In fig. 1.14 planes ABCD and EFGH are parallel planes. Write the remaining pair of parallel planes.

***** EXERCISE 1.1 *****

FIGURE 4.1: 2D image of 3D cube

to which I chanced upon a book in which was contained a theorem that spoke of a n -dimensional cube (n -cube, for short). The write-up presented a mathematical approach towards constructing an n -cube that proved useful in communicating a 3-dimensional cube to Faiz - We defined an n -cube as a unit of an n dimensional space. Starting with a point, which was to be a zero dimensional unit, we constructed a 1 dimensional unit, or 1-cube by constructing another point a unit distance away, and then joining the corresponding vertices. In general, an n -cube can be drawn by constructing an $(n-1)$ -cube and then another identical $(n-1)$ -cube a unit distance away, and joining the corresponding vertices.

I asked Faiz if he could, continuing in this manner, draw a 3-cube on my palm (using his fingers). He began:

Faiz: First I will draw a 2-cube, which is a square. And next to it I will draw another square. And I will join the points.

Having constructed the 3-cube on my palm, Faiz could easily point out which planes were parallel and which were perpendicular. For fun, I asked whether he could draw a 4-cube. Without hesitation he began by drawing a 3-cube on my palm and said:

Faiz: First I will draw a cube and next to it I will draw the same and join the points.

I did not anticipate that Faiz would manage to communicate a 4 dimensional hypercube to me, let alone do it with such ease. To overcome the contradictions of communicating 3 dimensional abstract objects entailed "authentic mathematizing", or redefining mathematical ideas as a whole. The mere making of diagrams tactile did not solve the problem of non-tactile diagrams. The lack of tactile diagrams proved to be a small symptom of a larger problem of Ableism. To overcome this hurdle entailed radically

altering our perspective towards “learning” the concept of a cube. And in doing so, not only did we develop a deeper and broader understanding of the concept but also realized that questioning a given concept and changing our perspective on the learning of mathematical concepts (from changing our understanding of concepts as a reified assessable thing to the result of a creative process) could also contribute to creating an enabling learning environment.

By “mathematization” I do not mean the final outcome of our exploration (in this case, of the cube) but the exploration. The exploration did not lead to an expected outcome from the student, but at the same time, the outcome was not something that could be characterized as a misconception. Had the interaction been with some other student, the outcome would have been something completely different. But what would have been common would be an authentic exploration of a mathematical concept that involved looking into the various properties of a cube and perhaps certain properties of other mathematical objects that shared some properties with a 3 D cube. My interaction led to a hypothesis that this change in perspective has a potential to be inclusionary. This hypothesis was explored at a summer camp which I will discuss in a later subsection.

4.1 Individualization versus collective learning

In addition to mathematization, another crucial aspect of teaching that I identified as central to creating inclusive learning environments is what I refer to as collective learning. To demonstrate what I mean I share an interaction with a student who I refer to using the pseudonym, Rina. At the time of recording this interaction, Rina was in the 9th standard and was studying for her on going exams. I had volunteered to read out her textbook to her while having the audio recorder running so that she could have the mp3 recording of the lesson. In the midst of reading her book, Rina narrated her experiences of being discriminated against in the school. As the device was recording, her narrative too got recorded.

Rina had only recently been transferred into the school in question. What Rina experienced did not seem unusual at first considering that a visually challenged girl was discriminated against in a private school, she contrasted her experience with that in her previous (public) school in which she claimed to not face such discrimination. Both were regular schools (where teachers lacked knowledge of Braille, Sign language, etc.). With Rina’s permission, I share an excerpt of her narrative.

Rina began sharing her perspective on how society treats blind people and connected it with what she experienced in school.

Rina: Society has not, till even now, accepted blind people. . . . from the top they show that “Yes, we help them” but from “the inside/within”, their thoughts, mindset is not there, to help. . . . I don’t play with them, (They think that) “this will happen to her, that will happen to her.” That’s why I’m made to sit separately. . . . I have received (sports) medals; meaning everyone, blind as well as normal children would receive medals. . . . I showed that in school. Even still [the school teachers] would not know that in her also there is talent. . . . till now, their thinking hasn’t changed.

Rina expressed how although society claims to be helpful to blind people, it is all a pretence and merely superficial (“from top/surface”) and which becomes evident in how they treat blind people. In other words, while society may profess an egalitarian ideology, the real ideology (“from inside”) is revealed in practice where discrimination actually takes place whether knowingly or unknowingly. Despite having received medals Rina was not considered talented enough to be included.

Had Rina ended her narrative here, it could have been argued that Rina’s experience of discrimination might have been an inevitable outcome of being a blind girl. However, Rina continued by stating that she was not discriminated against in the government school in which she studied till class 8th. Also, as Rina expressed, neither was her friend, Ravi (pseudonym) who also studies at the centre, discriminated against.

Rina: . . . my school before this, . . . was very good. I did not at all feel different. . . . And even Ravi (another student of the centre), they cooperate. . . . And right in the front they keep me. Like in sports, etc. Yes, Anytime if anything happens then [the teacher] tells me. In this school so much discrimination doesn’t happen.

Rina used the term “include” to show how she was not discriminated in the government school. Rina claimed to not feel different at all and attributed the reasons to her friends and her teacher for cooperating with her. It was clear to Rina that her ill-treatment was not an outcome of her blindness but rather of how society deals with blind people. Referring back to her current (private) school, she continued narrating how she was discriminated in her new school by being excluded from participating in every activity.

Rina: But this private school, they [discriminate], very much . . . keeping me separate. . . . it might be with me also, meaning that I also didn’t manage to be involved.

Rina had highlighted that her current school was a “private school.” Unlike her previous school in which she studied till the 8th standard, here she had to pay fees. Also, since she was in the 9th standard, the “no detention policy” (which stipulated that no child can be held back till the 8th standard) as introduced by India’s Right to Education (RTE) Act of 2009 no longer applied. Rina’s was in fact even denied admission in the private school on the pretext of her blindness. Only after a relentless struggle by the centre teachers was Rina finally admitted. Considering India’s history of denying education to oppressed castes in addition to having a detention policy certainly contributed to Rina being perceived as being destined to fail and therefore treated as a preordained failure who may be denied the right to an education.

Rina’s narrative concretely illuminated the social dimension of disablement as well as enablement. Through Rina’s experience, it became rather clear that *exclusion was not the result of her disability but rather, the cause of her disablement*. But this observation indicated a radical corollary that blindness need not disable blind students from learning mathematics. This hypothesis needed to be tested. Incidentally, the centre manager inquired whether we could take some extra classes during the forthcoming vacations. Using this invitation as an opportunity, at the end of the children’s exams, through a discussion with the centre teachers, I proposed the idea that we have a mathematics summer camp. The centre teachers and students were happy with my proposal.

4.2 Can blindness *really* need not mean disablement

Just after the exams, during the students vacations, as per the students request, we had organized a mathematics camp. We were three researchers and 15 students aged between 9 and 20 years. The students were either partially or completely blind. All spoke Marathi, and Hindi was their second language. The sessions were audio recorded and observations were noted. The discussion were carried out in Hindi (since we found Marathi difficult). We sat in a circle on the floor and asked the children their difficulties in mathematics. Through the course of the discussions, we decided that our session would be around the topic of divisibility. The interaction with the students during the time spent with them helped us cover various topics in mathematics. The redefining of mathematical ideas proved central to making inclusive learning possible. For example, on discussing odd and even numbers, the number zero came up. The students all agreed that zero is both an even as well as an odd number - it is *even* because on dividing nothing among two people, nothing remains; however, it is also odd because if nothing is there, it can’t be divided among two people since nothing is there to divide. However, a student named Faiz stated that he made a definition by which zero would be only even

and not odd. Faiz said that he observed that $\text{odd} \pm \text{odd}$ is even; $\text{odd} \pm \text{even}$ is odd and $\text{even} \pm \text{even}$ is even; now $3 - 3 = 0$, therefore 0 is even. As I presented in [D'Souza \(2016\)](#), during a discussion on negative numbers Faiz drove us to explore the question of where negative numbers come from. Faiz presented a more materialist perspective on mathematical ideas. For Faiz, mathematical concepts were not to be seen as a given collection of undebatable claims existing independently of human mediation. He argued that mathematical concepts are not to be taken as the starting point of a mathematics discussion to be fitted into an example, but insisted that they are developed by people for a reason.

During a later session while revising even and odd numbers the students argued that zero is not an even number - unlike even numbers, 0 has a distinct property - if you keep dividing any even number (2, 4, 6, ...) by 2, you will sooner or later arrive at an odd number. This does not happen with zero. The debate around the parity of zero forced us to think deeper about numbers, and made us discover contradictions in our arguments on the evenness of zero and the nature of definitions. The students agreed to refer to zero as an even number in the context of exams, but they kept defending the special status granted to the number zero.

Although I believed in following constructivist teaching, I often found myself getting them to arrive at the "correct" answers and definitions not realizing that such a practice was shaped by an ideology that functioned in getting students to compete with each other. Had I succeeded, some students would lagged behind and I would have reinforced the understanding that exclusion (in this case, the lagging behind) is an expected outcome of disability. Fortunately, the students ensured that their friends were included in every discussion, and effectively resisted the kind power that I was exerted.

Despite having students with various diagnosis of disabilities in the classroom, the sessions were rather inclusive and democratic owing more to a collective behavior and a spirit of cooperation and empathy among the children than to my own efforts as the teacher. Faiz, along with the other older pupils ensured that every student was taken along as the discussions proceeded. I suspect that they may have been doing this because they realised that some of the other students were not understanding, that my teaching was not very effective, and that they could better understand the problems the other students were having and how to help them overcome these problems. Also because the sessions were relatively informal and with only 8 to 12 students, they had the agency to do this. The students had a significant control over the pace of the discussion and ensured that none of their peers were excluded. The children engaged in mathematization of the ideas discussed and could thus take ownership of their mathematical knowledge and redefined the very norms of mathematics learning, by creatively engaging with, and

bringing their own mathematization to the learning process - by redefining mathematical concepts based on their observations.

4.3 Three components of inclusion

A significant aim of our mathematics camp was to test the hypothesis whether, consistent with the social model of disability, blindness need not disable students from learning mathematics, an insight having implications even for the larger education research community. There were three notable features of the mathematics summer camp that I found to be central to making it more inclusive than most regular classrooms:

1) A variety of educational aids available, 2) A culture of empathy and cooperation that arose from a collective behaviour among the students which facilitated social learning thereby resisting an alienating culture of rivalry and competition, and 3) An environment conducive for authentic mathematizing rather than merely accepting a body of assessable knowledge.

Chapter 5

Study 2: Limits of Inclusion - Beyond the Classroom walls

In this chapter, I present a follow up study by focusing on two students, Faiz and Binita, who demonstrated exceptional mathematical proficiency and interest. I narrate this in the backdrop of my interaction with another student, Sunny (pseudonym).

Faiz and Binita had expressed their desires to pursue higher mathematics. Both went on to finish their schooling and scored well in their exams. However neither managed to fulfill their dreams of pursuing mathematics. The reasons behind why this happened were brought to the fore during my interaction with Sunny. Sunny had joined the study later, was not a part of our learning sessions.

I present the case of my interaction with Sunny in the context of me volunteering to be his scribe for an entrance exam for a job. I choose to highlight this particular episode since it served as an effective case study of how the dominant form of mathematics content plays a major role in serving the economic demands of the labour market by producing justifications for the unemployment of those who are denied a job opportunity.

5.1 Background

We often received requests from the study centre to accompany a student for an exam as their writer. I volunteered to be Sunny's scribe. The exam in question had four sections - Logical Reasoning, Science, General Knowledge and Mathematics. Hundreds of candidates, most with writers, had reported at the exam venue. Although the exam was for a government job, the entrance exam was outsourced to a private agency that owned hundreds of computers in their office space. After a security check, we were

assigned a computer and a young examiner was assigned to watch over us probably to ensure that I do not help my candidate. However, this could not have stopped me from cheating (i.e., using my mathematics knowledge to answer his questions) since we were allowed to talk. Hypothetically, we could have developed a code wherein if Sunny did not know an answer, he could have asked me to click on a “random” option and proceed. This would not appear to be cheating even if all the “random” clicks turned out to be the right answer. There were hundreds of candidates in our centre alone. Examination centres were all across the country. However, the number of job openings was about a hundred. The entrance test was aimed at filling the quota for physically handicapped candidates. Thousands of candidates had appeared for a government job that would select a hundred candidates with different kinds of physical impairments, not necessarily related to blindness. Most of the mathematics questions clearly indicated that whoever framed them had a complete disregard for the fact that a significant proportion of prospective candidates were blind students (or else they had explicitly wanted to sift out blind students). In addition to word problems involving compound interest and complicated algebraic equations, even the exercises related to arithmetic were framed in a way to make it impossible for a blind candidate to solve. It was not that the questions were difficult - there are many difficult problems that blind students could do as well as sighted students. A few questions were of the following form (only the digits are different with no observable pattern that could make the problem simpler):

$$190 + \{45 - [17 \times (14 - \overline{6 \times 7})]\}$$

Sunny who was rather politically conservative in terms of valuing ideals of honesty among other virtues found himself asking me, “Sir, can you simplify the question?” to which I replied, “If I solve the bar bracket first and continue like that, I get the answer, -241.” “Is that in the options?” Hesitantly, I responded, “Option C is -241.” “Then select option C.” That felt really awkward and scary considering it was happening below an examiner’s nose. We ended up cheating in an exam (even if it was not more than 3 - 4 questions) in which the consequences for malpractice was severe.

However, as the exam ended, conversations with a few other candidates revealed that such cheating was quite the norm, and by the looks of the design of the question paper, it was expected that blind candidates cheat. Further, as Sunny let me know, the entrance exam was not followed by any interview but was in itself the deciding factor behind getting the job. Further, the opening was for a low level unskilled profession that obviously did not require any knowledge of Mathematics. It was evident to both of us that the only reason such difficult questions featured in the test was so that a random set of hundred students could be selected from among thousands of applicants which was

necessary owing to the gross unemployment in our country. But through the use of an entrance exam with mathematics in it, the onus of getting an employment was put on the disabled candidates. And a “failure” to find employment could easily be attributed to the candidate’s inability to reason logically and possess basic general knowledge.

This incident was not exceptional as was revealed by Binita who finished her schooling a few years ago. Binita narrated her interaction with a sighted friend who proudly spoke about how he cheated when he volunteered as a writer for a visually challenged candidate. Binita shared her concern of the far reaching implications that cheating can have on other blind people whose abilities would be brought into question owing to the pervasiveness of cheating. In fact, days after taking Binita’s interview, a student let me know that she was failed and made to leave her school on the pretext that she made her writer answer her examinations. I was one of the writers. However, in the exam, the questions were such that no writer who hadn’t studied the specific text book could have possibly cheated. All of the writers affirmed that they did not, and in fact could not have cheated especially because she was the only blind student and there were two invigilators in the relatively small air conditioned classroom with less than 20 students.

To contextualize her argument, she cited the case of Faiz who is now employed as a phone operator in a hospital ¹. Faiz had often expressed his desire to pursue higher mathematics so long as I would tutor him along the way, to which I happily agreed to oblige. But like it happened with Binita, Faiz was also discouraged from pursuing higher mathematics. His underemployment was justified owing to his having a high school certificate that indicated a “lower level²” mathematics. Compared to Faiz, Binita’s other friend was more fortunate to be employed in IT in a prestigious firm. But he too found himself without an opportunity to utilize his knowledge. Faiz’s journey from school to college and thereafter to the labour market revealed a *contradiction* between *producing* a mathematically competent workforce and *realizing* that competence albeit in an economy that does not offer adequate employment opportunities to facilitate that realisation.

5.2 Contradiction of production and realization of mathematical proficiency

One of the motives of creating an inclusive mathematics learning environment, at least as we would want to believe, is to help children attain a certain degree of proficiency

¹At the time of writing this thesis, Faiz was also studying to pursue a degree in Law

²As mentioned in Chapter 4, students with disabilities had the option of being exempted from being tested for 10th standard mathematics content in their SSC examinations and could opt instead for 7th standard math exam paper

in mathematics, or in other words, develop an “ability” to do mathematics. But this ability remains latent until it is expressed through mathematical practice or put to use (whether directly, to solve a maths related problem or play/develop mathematics puzzles for leisure, or indirectly, to provide a mathematical solution to a client, etc). However, under capitalism, opportunities for expressing one’s mathematical creativity or ability is severely inhibited either because of lack of meaningful jobs in the market where mathematical creativity may be expressed, or because the increasing length of the working day eats up into the time one might reserve for maths for leisure. The *production* of a mathematically abled workforce, and the *realization* of that ability, thus forms a contradictory unity under capitalism since *production* cannot be separated from, and also comes at a cost of, *realization*. Since only a handful of mathematically able workers will eventually be employed where they may use their mathematical ability, the greater the number of such workers produced translates into a lesser chance for a trained individual worker to find an opportunity to realize their developed capabilities³.

While Faiz had successfully overcome ableism in mathematics education at various levels, and developed a certain proficiency in mathematics, his proficiency could not find expression beyond the highschool classroom and into college and thereafter, in the labour market. Faiz’s experience of being unable to pursue mathematics was not a unique case but a general trend. As a student leaves the sphere of learning and enters into the labour market, they find themselves confronted by a different set of challenges and contradictions created by the market that prevent the realization of their mathematical potential. When blind students are “encouraged” to pursue lower level mathematics, their underemployment is legitimized through their high school certificate that displays their having completed only a lower level mathematics exam.

The economic contradictions of schooling as illuminated by the obstacles faced by Faiz, et al. also contributed to shaping social relations between sighted and blind people. For example, as Binita lamented, the fact that “cheating” was considered normal and expected among blind candidates had severely impacted how achievements of blind students were perceived by their sighted acquaintances.

To summarize this chapter, the political and economic dimension of schooling which became apparent outside the classroom revealed the contradiction that it is indeed possible to remain apolitical and create an inclusive and *enabling* learning environment but only to the extent (limit) that inclusion does not disrupt larger political economic processes that help generate surplus, and create and impose *disabling* conditions inside the classroom.

³In fact, even the few companies, who do employ youth for jobs involving mathematics, spend a few months training their selected candidates (to make be “able”) to carry out their required job.

Chapter 6

Concluding analysis: So what does the social model of disability mean for mathematics education?

The research study seen through the lens of social model of disability illuminated the structural nature of the disablement of blind students. As a philosophical framework, the social model of disability offered a worldview which highlighted the dynamic nature of human society as a whole, by locating the present as a part of history, and shed light upon the interconnections between various aspects of society including mathematics education, exclusion, disablement and the political economy. Analysing my field observations using the social model of disability, led to the conclusion that *while inclusive learning is achievable, an inclusive pedagogy in itself does not serve to disrupt or transform material economic conditions that begets exclusion, disablement and ableism.*

The field study began with the recognition that disablement is socially produced, and it sought to explore what can such a perspective mean for mathematics education. My research drew from, and lent support to the works of disability studies scholars like Michael Oliver, Roddy Slorach, et al., and Critical Mathematics Education (CME) scholars like Ole Skovsmose, Alexandre Pais, et al. whose writings highlighted ways in which disablement and mathematics education are embedded in a social structure. Mathematics educationists like Gutstein, et al. described CME as involving critically reading the world and politically engaging with it. But Skovsmose had pointed out that this may be a challenge for blind students owing to, among other reasons, “the relationship between Braille and mathematical symbols”.

However, through the use of a Case Study research methodology in a study centre for blind children in Mumbai, the field observations indicated that, at least within school mathematics, the visual nature of mathematical symbols was not the primary hurdle

preventing blind children from accessing and using mathematics meaningfully. Rather it is the social conditions within which students are embedded that *disable* them from using mathematical knowledge in meaningful and empowering ways. However, consistent with Giroux's observation of the dialectical relationship between power, ideology and resistance, the students also exercised resistance against disabling ideologies like competition, if it entered into their learning environment. For example, the students saw to it that none of their peers were excluded from the discussions, and challenged mathematical statements that I assumed to be unquestionable.

Skovsmose (2004) had argued that for mathematics to work in the interest of democracy, a mathematics classroom must also show aspects of democracy. To realize the concerns underlying his argument appeared to be an open challenge which was to a large extent addressed by the research study. As I described in chapter 4, there were democratic practices in our classroom setting, albeit not because of my individual effort but because of the collective behaviour exercised by the students. However while democratic practices within the micro-society of a classroom was achievable, the question of whether such a classroom could be characterized as contributing towards a larger struggle for an equitable society was brought to the fore when the political economic dimension of exclusion was made apparent while following up with the students after they finished schooling and sought higher learning and jobs. The field observation beyond the classroom seemed consistent with the argument of Pais who rejected the use of mathematical thinking as a means of achieving "high ideals of peace, democracy, social justice and equality". However, my study showcased a different relationship between mathematical thinking and ideals of equity. It was the equitable character of the learning within the classroom that facilitated genuine mathematical thinking, if not the other way around. Considering the structural nature of exclusion and disablement, developing an equitable classroom can hardly be considered as moving towards structural change, but is nonetheless necessary. Perhaps, only by engaging with excluded students can we understand the limits of apolitical individual actions in addressing problems related to exclusion, that are by nature economic, political and structural.

The question of what the social model of disability can mean for mathematics education, has implications for disability studies as well as education. And exploring this question highlighted various complexities related to the social and political economic aspects of education. However the study also offered some practical suggestions. I categorize the implications of my study into five sections. The first concerns theoretical aspects of the social model of disability. The second, third and fourth implications focus on pedagogical aspects of the teaching sessions which proved to be useful in facilitating inclusive learning. The fifth implications addresses the limits of pedagogical implications and the need for collective action.

6.1 Some implications of the study

1. Rethink the Social Model of Disability

The social model of disability is not simply a recognition that disability has a social dimension, but a radically different way of looking at society as a whole. It recognizes the present as a part of a history that is rife with class struggles, and regards individuals and their problems as embedded within a social structure. And this feature of the social model makes it inconsistent with other models of disability that do not take into account the historical and political economic aspects of society, and which regard society as a collection of individuals, with the isolated individual as its unit. These models include sociocultural models of disability as well as the human rights model of disability. We therefore need to rethink what do we mean by “the social model of disability” more so in the context of academia which often speaks of the social model from a postmodernist standpoint.

2. Facilitate collective behaviour and social learning in classrooms

A notable conclusion of my research based on my interactions with the students at an individual and group level (as described in chapter 4) was that students do not naturally behave in a competitive fashion. In fact, at times I found that it was me who was imposing an environment that could have led to a competitive behaviour among the students. Competitive and individualizing ideologies insinuate into classrooms given the larger sociopolitical environment in which schools find themselves. And therefore, as educators, we must consciously strive to create conditions for collective behaviour and social learning in our classrooms.

As the data from chapter 4 suggested, despite having students with various diagnosis of disabilities in the classroom, there was a fair amount of inclusion and democracy in our sessions. This had less to do with either my intervention or even with the available assistive tools, and more to do with a culture of empathy and cooperation developed by the students. The older pupils ensured that every student was taken along as the discussions proceeded. Perhaps they did this because they realized that some of the other students were not understanding, that my teaching was not very effective, and that they could better understand the problems the other students were having and how to help them overcome these problems. However, it helped facilitate inclusive learning.

The contributions of the teachers involved in creating such an atmosphere cannot be overlooked. While it is true that once the students leave the confines of the classroom and enter the labour market they will be made to compete, we need to have faith in the agency of the children we educate, and their potential to transform the world into a more humane and enabling social environment.

3. Facilitate mathematization

Faiz's materialist approach to mathematics was a salient factor behind the democratic nature of the teaching sessions. By mathematizing Faiz also encouraged his peers to do the same due to which the nature of the mathematics knowledge disseminated in the classroom was incompatible with assessment and grading, and contributed to democratizing the mathematics learning. This implication could be commonly held by educators even if they do not share my perspective on equity issues in mathematics education. For example, [Civil et al. \(2017\)](#) draws from the work of [Louie \(2017\)](#) who contrasts "exclusionary and inclusionary teaching practices" in which inclusive teaching is characterized by the understanding that "Mathematics is about making sense of ideas and understanding connections" as opposed to the "exclusionary" practice in which Mathematics is seen as "a fixed body of knowledge to be absorbed and practiced" and which considers "Correctness" as "paramount". Civil also showed how Louie's "sense-making frame" served to develop "students' self-confidence and ownership of their mathematical ideas" and shift "the authority from the teacher to the student," and that inclusive mathematics teaching practices "communicate to students that their peers are a valuable resource for learning mathematics" (p. 248).

I therefore use the term "authentic mathematization" to differentiate it from the argument of Civil, et al. who although emphasize on the importance of meaning making, etc. don't deviate from what [Roth and Mukhopadhyay \(2012\)](#) refer to as "the canonical practices of mathematics" that attempts to get students to "mathematize" or construct the "correct" or canonical body of knowledge. In the case of our teaching sessions, the students began their investigation into mathematical ideas based on their observations of the real world as well as their observations of properties of numbers. They did not try to fit their observations into some pre-existing mathematical concepts given in the book. In fact Faiz made this explicit when he argued that mathematical concepts are not to be taken as the starting point of a mathematics discussion or as though existing a priori and to be fitted into an example, but are developed by people for a reason. Mathematization also facilitated ideas that questioned the "canon". And this authentic mathematization was a byproduct of collective behaviour.

As mathematics teachers, we must recognize as Faiz demonstrated, that mathematics is a social process rather than a given thing. Taking into account that mathematical ideas have human histories, contributed significantly to challenging the authority of the teacher whose uncritical views on mathematics implied that some students being left behind is a natural outcome of any diverse learning environment. The students' expressions of different mathematical ideas served to resist power that was exerted through mathematics teaching. If we wish that children use mathematics meaningfully to critically interpret and politically engage with the world, it is equally important to create conditions wherein children build a sense of ownership of mathematics. Presenting mathematics as some alien and

assessable thing whether to be consumed in a top-down manner or even constructed is alienating. We therefore need to rethink how we conceptualize mathematics.

4. **Universalize Braille and tactile teaching aids**

My field experiences uncovered various affordances offered by tactile teaching aids (for example, using abacus to discuss the divisibility rules for 9), which have hitherto been considered unnecessary to students in regular classrooms. Tactile modes of communication like Braille offered affordances in terms of learning as well as argumentation. Unfortunately such teaching aids are considered the language of the blind. It is not only contradictory to speak of an inclusive classroom when one group of students are taught to read only print while another are trained in Braille, but also prevents children from exploiting the affordances offered by these devices. The challenges in realizing CME in the context of blind mathematics learners (as discussed by [Skovsmose \(2016\)](#)) is partly due to norm of restricting Braille to blind students rather than universalizing it as a mode of communication that could benefit society as a whole.

Since the [Draft NEP \(2019\)](#) recommends that young children learn three languages, we must insist that Braille and sign language as a form of communication be taught to all children to especially break the barrier between the sighted and the blind, between the deaf and the non-deaf, etc.

5. **Recognize and confront the political economic dimension of schooling and exclusion**

Another limitation of the research work of Louie, Civil, et al. is that while they reject the rote learning paradigm they don't explain why that paradigm still continues to dominate mathematics education. Also, while talking of inclusion, they don't take into account the political economic dimension of exclusion and disablement, and the limits of a inclusive learning in the struggle for equity. By providing a dialectical perspective on disablement, the social model does not limit its analysis on disablement within the classroom but looks at society in its entirety. Taking into account the political economic dimension of disablement as afforded by the social model view makes room for understanding and concretely addressing the limits of a "sense-making frame" in terms of addressing equity concerns.

The experience of accompanying Sunny to his entrance exams, and the dilemmas that I was compelled to confront, highlighted the interconnections between mathematics education, unemployment and disablement. The experience, as described in chapter 5, highlighted the structural nature of exclusion that renders it unamenable to mitigation by individualist approaches like adopting an inclusive pedagogy.

Contradictions such as rising unemployment amidst a rising GDP is inherent to the political economy of Capitalism, and is inextricably linked with schooling, failure and exclusion. And so is the contradiction between increase defense spending on

the one hand and a lamentation about lack of funds to make education accessible to all children irrespective of their caste, gender, learning needs, etc. on the other. Therefore, any attempt to solve to the problem of exclusion has to include a political program aimed at replacing this inherently oppressive and disabling politico-economic social order with a more equitable and humanist one.

Furthermore, we need to realize that the very concept of “inclusion” is premised on an individualist understanding of society that takes mass exclusion for granted. [Sadgopal \(2019\)](#) highlighted how “the term inclusion came into Indian political discourse for the first time with the 11th Five Year Plan Report in 2010-11.” Sadgopal argued how under “Neoliberal Brahminical Capitalism,” inclusion “allows the ruling classes to not just continue with inequality but also to increase it at all levels and in all facets of national life and then ‘Include’ a minuscule proportion from SCs/STs/OBCs/Muslims... on selected parameters.”

To speak of “limits” of “inclusion” is not to suggest that exclusion is immutable, but rather, a challenge to be confronted collectively and politically.

6.2 Further questions

Through the lens offered by the social model, the exclusion of blind children highlighted the exclusionary nature of schooling as a whole. However, my conclusions were developed based on a study that was specific to a group of blind students in an informal learning environment. While I did draw insights from my experience in teaching regular classrooms as well as with non-disabled school students who visited HBCSE for camps, I did not explore deeply enough how the dialectical relationship between power, disablement and resistance operate in regular classrooms among non-disabled students. And this question is worth exploring further if we wish to develop a more dialectical conception of education, schooling and exclusion.

Also, my work did not adequately get blind students to do what Critical Mathematics Educators like Gutstein and Skovsmose have argued for, namely to critically read and politically engage with the world using mathematics. The study recognized that mathematics education itself was complicit in disempowering blind students, and thus regarded addressing oppressive ideologies within mathematics education as a prerequisite to get students to engage politically with mathematics and society. While I believe that the study did add an important insight to the question of how can mathematics education be used in our struggle for social justice, the question of how to meaningfully include blind mathematics learners in this larger political battle needs to be explored further.

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