

Conceptualizing Justice-centred Science and Environment Education in the Context of the M(East) Ward in Mumbai

Synopsis of Ph.D. Thesis

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Abstract

This thesis is premised on the assumption that education can play a significant role in social transformation, and critical scientific, technological and environmental literacy is a must to change the social order that is oppressive to people and the natural environment. Building on the critical strands within the fields of science and environment education, the thesis aims to develop a systematic critique of the formal educational discourse from the perspective of marginalized communities such as the M(East) ward in Mumbai city and explore the possibilities of a justice-centered science and environment education. In the context of the M(East) ward - the most neglected municipal ward in the city - waste seemed to be the most promising theme to initiate discussions on social and environmental justice as one of the largest dumping sites in Asia, the Deonar dumping ground, is the central identity of the geographical region. Waste as a curricular theme is closely linked with various science and social science topics, such as health, materials, development, and environment which were the focal themes in the study. The study had a threefold agenda: 1) Critically examining the educational discourse on focal themes, 2) Exploring students' life worlds, and 3) Conceptualizing a model of justice-centered science and environment education in that context.

The work is broadly situated within the realm of critical qualitative inquiry as it adopts two overtly political methodologies - Critical Ethnography and Critical Discourse Analysis – to address the research objectives. The participants in the study comprised of Grade IX students, science and social science teachers from local schools, and an array of people working in the domain of waste (rag pickers, scrap dealers, professionals working in the waste management sector, trade union leaders), and field associates and officials of organizations such as Apnalaya, SWaCH, and the Tata Institute of Social Sciences' Transforming M-ward project. The analysis of the educational discourse involved a critical examination of the science and social science textbooks, classroom teaching of relevant topics, and formal and informal interactions with teachers and students of the M(East) ward.

The findings indicate that the educational discourse on selected themes is largely decontextualized and depoliticized. By not providing any space for their voices and concerns on an issue so central to their lives, the curriculum exerts 'symbolic violence' on the students. The explorations into students' life worlds brought to the fore not only their rich experiences, values, knowledge, concerns, cultural beliefs, political views, but also a medley of emotions such as shame, agitation, and more importantly,

undaunted hope that the situation can be changed. Further, based on my interactions with students and other participants, I try to delineate a justice-centered model with regard to the theme of waste in terms of conceptual ideas, discussion points, activities, and resources that can be employed.

A quick overview of the thesis

The thesis is divided into six chapters.

In the first chapter, I dwell upon the need for a transformative science and environment education, examine the relevant curricular documents, and present a historical context of Science-Technology-Society (STS) Education and Environment Education in India. The research objectives are also spelled out.

The second chapter provides an overview of the theoretical and empirical work that has shaped this research. The chapter begins with a discussion on a range of perspectives, approaches, aims and strategies that scholars have adopted in the field of STS and environment education. Special attention is paid to critical currents in both the fields. The merger of place-based education and critical pedagogy has been appealing to me and I discuss this idea at length. It provides a justification for focusing on a particular 'place' for the study.

In the third chapter, I describe the methodological orientation, the ontological and epistemological framework employed in the study, and various aspects of the research design. This is followed by a brief description of the study context, and the rationale of the study. Research questions are also outlined.

The fourth and fifth chapter of the thesis broadly encompass the findings of the study. In the fourth chapter, I have engaged in an 'oppositional' reading of the educational discourse on 'waste' from the standpoint of the M(East) ward students under three broad themes. First, I explore how waste is defined in the formal educational discourse and what reasons are provided for the large scale generation of waste, its accumulation and improper management. This is followed by the analysis of what effects of waste on the natural environment and human life are emphasized. Finally, I discuss what measures are suggested to overcome the problem. For each theme, I primarily draw upon the Grade IX science

textbook that is followed by the schools affiliated with the state board and the teachers' discussion of waste and its management in their classrooms. Further, to problematize the educational discourse, I also bring in data from out-of-school interactions with teachers and students in the community, and my interactions with varied groups of people who deal with waste on an everyday basis. Issues related to health and to the theme of materials are also discussed in the context of waste.

Since the issue of waste is organically interlinked to both environment and development, the fifth chapter is dedicated to a critical examination of the broader educational discourse on environment and development. I begin with a discussion on how nature is presented in the educational discourse i.e. what language is used to talk about nature, and how the relationship between humans and nature is portrayed. This is followed by a discussion on the understanding of development where I examine how development is defined in the textbook chapters, what markers of development are discussed, and how the difference between various development indicators is explained. The other important theme is the regional variation in development. Here, I explore what variations are highlighted in the discourse and what variations are ignored, and what kinds of explanations are offered for the regional imbalance in development. The last theme is the conflicts around development projects. A critical engagement with various aspects of development projects reveals the complexity of the topic for the learners. For each theme, I rely on my analysis of the relevant textbook chapters in science and social science textbooks, classroom observations, teacher interviews, and my interactions with the students of the M(East) ward in out-of-school settings.

In the final chapter, I summarize the critique of the educational discourse and the insights that I gained on students' life worlds. Based on my interactions with students and other participants, I propose an alternative model of justice-centred science and environment education in the context of the M(East) ward.

Chapter 1. Introduction

1.1 Need for a transformative science and environment education

Education is a political practice that can be used to either maintain the *status quo* or to conscientize people and bring change in the prevailing oppressive conditions in the society (Freire, 1972). The vital role of education in empowering people and breaking the shackles that restrain people from exercising freedom has been emphasized by Indian social reformers such as Jotirao Phule and B R Ambedkar as well. Both of these visionaries also perceived science in a liberating role and envisaged teachers and students as “modern truth seekers and agents of social transformation” (Rege, 2010, p. 93). Drawing inspiration from their ideas, this thesis focuses on exploring the possibilities of a transformative science and environment education. While it shares the vision of Phule and Ambedkar of a more equal and just society and the role of education in addressing historical injustices, it does not locate itself within the modernist, rationalist framework espoused by these visionaries of the late colonial period. Rather, the position advanced by this thesis is informed by various criticisms of science, technology and development mounted by post-colonial scholarship of the late 20th century (Nandy, 1988).

There is a growing consensus among the scientific community and the environmentalists that the world is on the verge of an environmental crisis. Global climate is changing, natural resources are dwindling, species are becoming extinct, ecosystems are degrading, and biodiversity is getting lost. This crisis has disproportionately affected people from marginalized sections who have faced detrimental effects on their health, safety, and livelihoods. Further, World Inequality Report (2018) shows that the income inequality is steadily deepening day by day (Alvaredo et al., 2018) and people are increasingly bound to live and work in dehumanizing conditions.

To bring any radical change to these intertwined socioeconomic and environmental conditions, both economies and ecologies need to be reconceptualized. This thesis is premised on the assumption that education can play a significant role in this reconceptualization and lead to social transformation. Since the current times are marked by the immense presence of science and technology in almost all facets of life, I believe that science and environment education particularly carry the responsibility of pursuing transformative goals. Moreover, the added onus is also owing to the fact that technoscientific advancement forms the backbone of economic development and that scientific rationality is often

invoked to justify policies related to environment protection or development. As Kyle (1999) argues, science and technology have unfolded in and strengthened a political economy that nurtures consumerism and individualism of an order that has “brought the world to the brink of global destruction” (p. 260).

1.2 Scientific literacy: A contested goal of science education

As science and technology increasingly mediate all sorts of human interactions, having basic knowledge of science and technology has become vital to survive in the system. “It is a striking feature of education systems the world over that science is invariably accorded high status, and allocated considerable resources, throughout the years of compulsory schooling. In low-income countries, where difficult choices about resourcing are inevitable, science is a priority subject” (Driver et al., 1996, p. 8). Ironically, only a miniscule of students get an opportunity to advance their careers in science and become a part of the scientific workforce. For the majority, science learning means, at best, gaining basic scientific literacy that prepares them to survive in the system and deal with specific situations that might arise in the future. Science education, therefore, has this dual responsibility: to lay a foundation in the discipline for a minority of students, and to improve public understanding of science by inculcating scientific literacy for the majority of students.

Interestingly, even though inculcating scientific literacy among students has been on the prime agenda of policy makers over the past 70 years, what constitutes scientific literacy has always been a matter of serious contention among science educators (Deboer, 2000). Roberts (2007) identified two broad positions (Vision I and Vision II) that represent different goals of science education on a continuum. While Vision I has the conventional focus on teaching and learning the ‘products’ and ‘processes’ of science, Vision II is about understanding the usefulness of scientific knowledge in life and preparing students to deal with situations that they are likely to encounter in the future as citizens. Sjöström & Eilks (2018) conceptualize another notion of scientific literacy i.e. Vision III, which is more politicized in nature and aims at “emancipation and socio-ecojustice” (p. 67). This vision is similar to what Hodson (2003, 2011) calls ‘Critical scientific, technological and environmental literacy’ (CSL). With the objective of conceptualizing a justice-centred science and environment education, this thesis is guided by Vision III and aims to contribute to the growing body of literature under the ambit of this paradigm.

1.3 Neoliberal pressures on science and environment education

One of the major hurdles in making the world an equal and just space is neoliberalism which has been the “central guiding principle of economic thought and management” since 1970s (Harvey, 2007, p. 2). Individualism, competition, deregulation, privatization, commodification, and increasing withdrawal of the state from matters of social welfare, are some defining characteristics of the neoliberal imagination. Bencze & Carter (2011) note that mainstream science education often works as an agent of neoliberalism, producing either a scientific force serving the interests of the global economic elite, or mere consumers of goods and services.

Carter (2008) illustrates how deeply globalization has impacted the agenda of scientific enterprise and science education. She argues that the focus of science education has shifted to mastery over scientific facts and competencies decided by the global market and expresses her concern that there is an overemphasis on learning canonical science. She urges for a science education that would “help students understand and make critical judgements about science in ways that can enhance their engagement to work for a more socially just, equitable, and ecologically sustainable world” (p. 628).

Globalizing ideologies have also significantly influenced the landscape of environment education (Jickling & Wals, 2008). Hursh, Henderson, & Greenwood (2015) claim that “neoliberal ideals promoting economic growth and using markets to solve environmental and economic problems constrain how we conceptualize and implement environmental education” (p. 299). A transformative science and environment education must address these concerns and help students develop systemic understanding of issues, a critical consciousness, a commitment to social and environmental justice, and competencies to take collective action.

It is not surprising that as the market pressures are increasing on scientific practice as well as the education system across the globe, voices of dissent are also rising from multiple quarters. In the 1970s, various people’s movements around the globe, including environmental movements, campaigns against the unethical drug trials in developing countries, protests against the nuclear power plants, movements around animals’ rights called into question the rapid pace and the nature of technological advancement, the profit-oriented technocratic development model, and the state’s complicity in the big science projects. These movements pointed out the need for a radically different education focusing on developing a critical perspective towards the nexus between scientific enterprise, global capitalism, and

the state, among many other things. To address these rising concerns, the STS (Science-Technology-Society) education paradigm emerged within the field of science education. In Chapter 2 of the thesis, I discuss various positions, approaches and strategies that scholars have adopted in the area of STS education. In the subsequent sections, I turn my attention to the Indian context and discuss the state of STS and environment education in the country.

1.4 STS Education in India

Despite parallel and contesting discourses on the role of science and technology in the country, the policy documents in post independence India have always portrayed science in a positive light. A recent policy document - NCERT's focus group paper on teaching of science - acknowledges the emancipatory potential of science and presents science as a tool for social change and addressing problems associated with socioeconomic inequality (NCERT, 2006b). A quick analysis of the document shows that the policy level discourse is caught up in the logic of scientism and any criticism of science and technology is yet to find space in the policy documents. This is despite the concerns raised by various PSMs about the role of science and technology in furthering the state's modernization and development agenda, and propagating these ideas through various grassroots initiatives since 1960s. There were two historic initiatives which operated at a reasonably large scale and adopted STS-informed perspectives in their conceptualization of science education. The *Keralā Shāstra Sāhitya Parishath* (KSSP) was the largest PSM organization in India that was formed in 1962 with the aim of taking science to common people. *Science for Social Revolution* was the slogan that captured the essence of KSSP's ideology. The *Hoshangabad Science Teaching Program* (HSTP), that was initiated in 1972 as an educational experiment, aimed at improving the quality of science education in the state of Madhya Pradesh by providing authentic but low-cost experiences of learning science to rural students. Science was seen in a liberating role and inculcating scientific temper among students was emphasized in the program. HSTP also envisioned science learning to be closely connected with students' immediate natural and social environments. Students were encouraged to bring examples from their contexts, critically reflect on their experiences as part of classroom activities as well as outside the classroom.

Among other notable efforts in STS education, is the activity-based foundation course on STS that was developed by Homi Bhabha Centre for Science Education (HBCSE) in the 1990s. Through booklets on

eight broad STS themes, the course aimed at introducing higher secondary students to real-world problems, sensitizing them to local issues, and enhancing their understanding of the complex linkages between science, technology and society. More recently, studies involving socioscientific issues have been conducted at HBCSE with an imperative of inculcating critical science education among students (Raveendran & Chunawala, 2015a, 2015b; Raveendran, 2018, 2021). This work is still in a nascent stage and more research is needed to explore how students negotiate various socioscientific issues embedded in local context (Raveendran, 2018).

1.5 Environment Education in India

Though respect for ‘mother nature’ and protection of environment have always been an integral part of the cultural ethos of the Indian society, any serious effort to introduce environment education (EE) into the Indian education system can be easily traced back to Gandhi’s *Basic Education* project that was initiated in 1937 (NCERT, 2006a). Aimed at social transformation through strengthening local governance structures, the project sought to foster skills for productive activity and inculcate values among learners by engaging them deeply in their local environments and community life. Post-independence, the National Education Commission (also known as “Kothari Commission”, 1964-1966) recommended making environment education a core part of the formal education.

This was also a time when environmentalists had started pointing out problems with various technoscientific development projects set up after independence in the name of nation building and economic growth. In 1976, the Indian Constitution declared protection of natural environment as a fundamental duty of all Indian citizens. The Centre for Environment Education (CEE) was set up in 1984 which spearheaded numerous programs for integrating environment education at all levels. The National Policy on Education 1986 (modified in 1992) stated ‘protection of the environment’ as an element of common core for developing a curriculum framework. The subsequent National Curriculum Frameworks (1988, 2000) reiterated the need for integrating EE into the curriculum (NCERT, 2006a). Further, in a landmark judgment of the Supreme Court of India (M C Mehta vs. Union of India and others, 2003), EE was made mandatory at all levels of education in the country and the states were advised to integrate it within existing disciplines in the curriculum. Following this ruling, EE received due attention in the formulation of the National Curriculum Framework in 2005, and EE was finally infused with other subjects across levels in the textbooks that were developed subsequently.

It is striking that several non-formal educational initiatives have also been instrumental in developing learning materials and implementing programs in schools. For instance, various people's science movements which were also concerned about diverse local and global environmental issues, initiated programs in environment education as well. Some of the most prominent among these are efforts by the *Keralā Shāstra Sāhitya Parishath*, the *Chipko* movement, the *Narmadā Bachāo Aandolan*, and the Save Silent Valley Campaign. These movements adhered to the ideals of critical environmental education to varying degrees and questioned the “dominant development paradigm that accelerates economic disparity and environmental destruction” (Sahoo & Pattnaik, 2012, p. 16). Mainstream environment education in India, however, is yet to embrace the critical ideas espoused by these movements as evident in its rhetoric of sustainable development (Haydock & Srivastava, 2019), and the technocentric approach to discuss environmental issues (Almeida & Cutter-Mackenzie, 2011).

While a systematic analysis of various educational programs, textbooks, supplementary material developed by government or private agencies is a must to examine the effectiveness of diverse approaches and strategies and design new learning experiences, very little documentation is available in any form.

1.6 Research objectives

As discussed before, research in critical science and environment education in India is in a nascent stage and there is a dire need to explore multiple cultural and socioeconomic contexts. This thesis makes an attempt in this direction by focusing on a particular geographical region, the M(East) ward in Mumbai, and exploring students’ understanding and experiences of select themes (waste, health, materials, environment and development) in the region. Through this thesis, I aim to develop a systematic critique of the educational discourse on the aforementioned themes in science and environment education from the perspective of the marginalized communities for whom these themes are central in their lives. Students’ everyday discourses on these themes are also explored and an attempt is made to offer an alternative discourse that is aligned with the principles of social and environmental justice. Thus, the study has a three-fold agenda: 1) Critically examining the educational discourse on focal themes, 2) Exploring students’ lived experiences and out-of-school knowledge with regard to focal themes, and 3) Conceptualizing a justice-centred science and environment education model for the M(East) ward community.

Chapter 2: Literature review

2.1 Various currents in STS(E) education

The field of Science-Technology-Society (STS) education emerged in response to the criticism that the scientific enterprise faced in the 1970s from various quarters. STS education “places science squarely within social, technological, cultural, ethical and political contexts” (Pedretti & Nazir, 2011). A quick analysis of the work that has happened under the STS banner since then indicates the way these concerns have been implemented by various science educators. Pedretti & Nazir (2011) present a useful characterization of the field as they claim to go beyond “how STSE¹ might be integrated into science curriculum” to “why and what of STSE education” (p. 605). Based on the focus, the aims of science education that informed the work, the dominant approaches and the pedagogical strategies employed, they identify six major currents in STSE education that “coexist, overlap, inform one another and can be used in harmony” (Bencze et al., 2020, p. 832).

The application / design current focuses on problem-solving through technological design projects. The historical current emphasizes the historical embeddedness of the scientific practice. The logical reasoning current is one of the dominant currents within STSE education. It is premised on a positivist assumption that socioscientific issues, irrespective of their complexity, can be best addressed through a scientific approach and logical reasoning. Thus, developing students’ competence in argumentation, decision-making, logical reasoning, risk-benefit analysis, stakeholder analysis are some of the common strategies adopted in this current. The value-centred current endorses the view that values are an integral part of people’s consideration of socioscientific issues. Moral reasoning in students’ negotiation of socioscientific issues is emphasized. The proponents of the socio-cultural current mostly working in multicultural and non-Western contexts believe in cultural pluralism. Science is presented to students as an important cultural and intellectual achievement embedded in a socio-cultural context. The socio-ecojustice current focuses on “understanding the impacts of science and technology on society and environments” as well as “critiquing or solving these problems through human agency and

¹ STSE stands for Science, Technology, Society and Environment. In the beginning of the STS movement, environmental issues did not receive much attention. However, as the field evolved over time, the need was felt to include environment as well. That is how the STSE education came into being. The first time the word STSE was mentioned by Jim Gallagher in 1971.

action” (Pedretti & Nazir, 2011, p. 617). The advocates of justice-centred science education believe that “the aim of science education should be the promotion of a certain type of citizenship and civic responsibility of which transformation, agency and emancipation are key features” (p. 617). The work presented in this thesis can be placed within this paradigm.

2.2 Critical voices in STSE education

In line with the focus and objectives outlined above for the socio-ecojustice current, scholars such as Hodson (2003, 2011), Dos Santos (2009), and Roth & Barton (2004) advocate inculcating Critical Scientific, Technological and Environmental Literacy (CSL) as the primary aim of science education. In a seminal paper, Hodson (2003) argues that it is not enough to prepare students to cope with the demands of the changing world. Students need to learn to question the logic of the existing system and work towards transforming the world into a more equal and just space. Thus, the idea of a critical scientific, technological and environmental literacy is “inextricably linked with education for political literacy and with the ideology of education as social reconstruction” (Hodson, 2003, p. 660), and it can be achieved only through a politicized curriculum organized around real world issues that have a technoscientific or environmental dimension.

In the past two decades, scholarship in the field has bloomed rapidly. At a fundamental level, most scholars working within this paradigm agree on politicizing the curriculum around contextually relevant socioscientific issues. There is also an agreement over the need for perspective building through engaging students in dialogue and reflective exercises to the aim of inculcating values of social and environmental justice, and enhancing their “action competence” (Jensen & Schnack, 1997) through engaging them in concrete sociopolitical actions. However, the relative emphasis on various aspects and the constructs chosen to describe the goals are different.

For instance, Rodriguez (1998) proposed a framework of sociotransformative constructivism as “an alternative orientation to teaching and learning that takes into account how social, historical, and institutional contexts influence learning and access to learning in schools” (p. 590). In his framework, he identified four key elements of justice-centred science education – *dialogicality*, engagement in *authentic* activities, participation in *metacognitive* exercises, and *reflexivity*. Similarly, building on the Freirean humanistic perspective, Dos Santos (2009) put forth a radical view of scientific literacy characterized by organizing curriculum on socially relevant themes and socioscientific issues,

establishing a dialogical process in classrooms, and engaging students in sociopolitical actions. For Dimick (2012), the key question is whether as an outcome of school science education, students are getting empowered at various levels and she identifies three important arenas – *academic*, *social* and *political* – where empowerment needs to happen. Morales-Doyle (2017) sees justice-centred science education as a *catalyst* for social transformation and advocates blending critical pedagogy with culturally-relevant pedagogy. Tolbert & Schindel (2018) emphasize the need for confronting the ideology of consumerism and engaging students with the ethics of care.

Common to the scholarship is a key suggestion that the science curriculum needs to be organized around issues that are interdisciplinary in nature and issues that matter to people, and that “(s)cience education must be situated within social, technological, cultural, ethical and political contexts and realities” (Bencze et al., 2020, p. 829). This thesis draws upon the STSE education scholarship that advocates such an approach to a justice-centred science education.

2.3 Socially Critical Current in Environment Education

In an attempt to map the vast landscape of environment education, Sauv  (2005) discerns various currents based on the following parameters: a) conceptions of environment, b) implicit or explicit aims of environment education, c) main approaches and strategies, and d) illustrative pedagogical models. Of the currents identified, the socially critically current in environment education draws its inspiration from critical theory and seeks radical transformation of social and environmental reality. It “promotes analysis of the social dynamics underpinning environmental realities and problems: analysis of intents, positions, arguments, explicit and implicit values, and the decisions and actions of the various protagonists in a given situation” (Sauv , 2005, p. 23). Emphasizing the political nature of the current and its primary aim to transform realities, Sauv  asserts that, “Action plans emerge from or during investigation, in a perspective of emancipation, of freedom from alienation. It is a courageous stance, in that it begins by confronting oneself (one’s own beliefs, attitudes and values, the relevance and coherence of one’s own actions) and implies the questioning of commonplace ideas, received wisdom, and dominant trends” (p. 24). The pedagogy that is argued under this current stresses “the importance of addressing issues that are contextually relevant and significant to people, and highlights the fecundity of knowledge dialogues: formal scientific knowledge, experiential knowledge, traditional knowledge, local everyday knowledge, etc. These diverse types of knowledge must be compared and

contrasted, nothing must be taken for granted; diverse discourses must be appraised within a critical approach in order to better inform action”. (p. 24)

Thus, the socially critical current in environment education seems to be well aligned with the principles of socio-ecojustice current identified in STSE education as both emphasize finding ways to address contextually relevant issues, community-oriented projects, encouraging a dialogue between different kinds of knowledge and diverse discourses, and adopt a critical approach to better inform action.

2.4 From ‘Place-based education’ to ‘Critical pedagogy of place’

Layrargues (2000) argues that while global environmental problems such as climate change seem remote and offer little motivation for action, local environmental problems provide a meaningful context closer to the lived experiences of the community and render possibilities of action. The importance of the local context in making learning meaningful to students can be traced back to as early as the 1950s and can be discerned in John Dewey’s writings. In the mid-1990s educators from different parts of the world (primarily from the United States) began expressing concerns regarding students’ alienation from their communities and the natural environment. They advocated place-based education which would provide young students with the opportunities to engage with the human and natural environments that they actually inhabit (Smith, 2013).

Gruenewald (2003) maintains that ‘place’ is a critical construct as it “foregrounds a narrative of local and regional politics that is attuned to particularities of where people actually live, and that is connected to global development trends that impact local places” (p. 3). He further argues that place-based education is a radical idea because “current educational discourses seek to standardize the experience of students from diverse geographical and cultural places so that they may compete in the global economy” (p. 7). However, place-based pedagogies as practiced by various educational programs across the globe pay little attention to the larger structures and processes that shape the human and natural world. Similarly, critical pedagogy often lacks practical guidance for educators and neglects environmental concerns (Stevenson, 2008).

To bring back cultural and ecological politics at the center of place-based education discourse, Gruenewald (2003) advocates a ‘critical pedagogy of place’ (CPP) that synthesizes the traditions of

critical pedagogy and place-based education by utilizing the strengths of both the fields, and seeks “to contribute to the production of educational discourse and practices that explicitly examine the place-specific nexus between environment, culture and education” (p. 10). Dimick (2016) notes that despite CPP offering a powerful conceptual and pedagogical framework, there is a scarcity of empirical studies that utilize the framework in formal or informal science education, particularly in urban contexts.

I conclude this section with the reminder given by Stevenson (2008) that the time has come to shift the vision of ‘Think globally, act locally’ to ‘Think and act locally and globally’. Since India is a land of diversity – diverse cultures and faiths, spectrum of socioeconomic problems, and a whole range of educational practices, I believe there cannot be one formula for all contexts. Any discussion on critical science and environment education needs to be situated in a specific context. From a critical pedagogy of place perspective, I felt important to situate these conversations on social and environmental justice in my immediate neighborhood. In the subsequent chapter, I provide contextual details of this neighborhood i.e. the M(East) ward in Mumbai where I was staying during the course of the study.

Chapter 3: Study design

3.1 Situating the study: Case of the M(East) ward, Mumbai

Mumbai, the financial capital of India, is known as the city of dreams where millions of people from different parts of the country migrate every year to fulfill their dreams. The M(East) ward in Mumbai is one of the poorest areas in the city. For many poor migrants to the city, the slums of the M(East) ward happen to be the first choice to settle at affordable costs (Fig. 1). The M(East) ward hosts India’s largest open landfill site, Deonar dumping ground, as well which is spread over 1.32 sq-km area.

The area close to the dumping ground is densely populated with thousands of families directly or indirectly dependent on city’s waste for their livelihoods. Mostly inhabited by Muslims and Dalit Bahujans (communities ranking lowest in most socio-economic indices in the country), it does not seem to be just a coincidence that the M(East) ward happens to be the most neglected municipal ward in the city with a Human Development Index (HDI) of a mere 0.05 while the average HDI for Mumbai is 0.56 (MCGM, 2009). A survey report published by a reputed social science institute in Mumbai

claims that the M(East) ward is “an extreme example of skewed development in the metropolis, with virtually all indicators showing an urgent need for action that is multi-dimensional, comprehensive and strategic to serve its burgeoning population” (TISS, 2015, p. viii).

3.2 Research questions

In the context of the M(East) ward of Mumbai, waste seemed to be the most promising theme to initiate discussions on social and environmental justice as one of the largest dumping sites in Asia, the Deonar dumping ground, is the main identity of the geographical region. For marginalised communities like the one living in the M(East) ward, the experience of waste is unique as it is a part of their lived reality as opposed to that of the middle class people whose engagement with waste begins and ends with dropping trash in designated bins. Waste as a curricular theme is closely linked with several topics that are discussed in the secondary science and social science curriculum such as health, materials, development, and environment.

This study aims to critically analyze the educational discourse on three themes – waste, environment and development (focal themes in the study), examine how empowering (or, disempowering) the educational discourse is for the students of the M(East) ward, and what possibilities lie in their everyday experiences to develop an alternative learning experience that is relevant, meaningful and transformative for them. Themes such as health and materials are discussed in the context of waste.



Fig. 1 Representative image of alleys in the M(East) ward
(Photo credit: Apnalaya, an NGO working with urban poor)

In particular, I seek to explore –

- 1) How is the educational discourse on focal themes positioned vis-à-vis the lived experiences and out-of-school knowledge of the students in the M(East) ward?
- 2) What funds of knowledge and discourses do students invoke from their everyday experiences while discussing the focal themes in out-of-school settings?

While the first research question is steered at developing a systematic critique of the educational discourse from the standpoint of the people of the M(East) ward, the second research question is aimed at eliciting cognitive and cultural resources owned by the students in the community. By systematically documenting these resources, the study seeks to contribute to designing a contextually-relevant, meaningful and transformative learning experience for the students of the M(East) ward and thereby, conceptualizing a model of justice-centered science and environment education in the particular context.

3.3 Research paradigm

The study is situated within the realm of *critical* qualitative inquiry as opposed to a *positivist* or an *interpretive* paradigm which work with a very different set of ontological and epistemological assumptions (Guba & Lincoln, 1994). Critical qualitative inquiry shares most of these attributes with interpretivism; what marks it out is its overt commitment to social transformation. Kincheloe et al. (2018) argue that a research can be qualified as ‘critical’ only if it seeks to “create conditions for empowerment and social justice... and confront structures of oppression” (p. 421).

3.4 Methodological bricolage

Unpacking an ideological problem often demands fundamentally questioning disciplinary blinders. The idea of ‘bricolage’ appealed to me as it seems to capture the essence of how a qualitative researcher brings together multiple methods, strategies, theoretical frameworks, perspectives and analytical approaches to make sense of the data.

Given that this study intends to develop a systematic critique of the educational discourse on certain topics from a justice perspective, and outline an alternative educational experience which is transformative and aims to conscientize students of the M(East) ward, critical ethnography seems to be

the most apt methodology to unpack the research problems. Critical ethnography is an overtly political research methodology which is centered around the idea of “praxis” (Lather, 1986) and critical ethnographers bear an “ethical responsibility to address processes of unfairness or injustice within a particular lived domain” (Madison, 2005, p. 5). However, as Anderson (1989) argues, “... there has been little evidence in practice of a recognition by critical ethnographers in education that language is a social phenomenon that is enmeshed in relations of power and processes of social change” (p. 262), I turn my focus to issues of language, and discuss critical discourse analysis as a methodology complementing my explorations in critical ethnography.

Critical Discourse Analysis (CDA) is a methodological approach that adopts an explicit socio-political stance, and is premised on an interest in understanding, uncovering, and transforming conditions of inequality (Rogers, Malancharuvil-Berkes, Mosley, Hui & Joseph 2005). One of the fundamental principles of CDA is that it understands language as a social practice (Fairclough & Wodak, 1997), which is not only determined by social structures but also “contributes to stabilizing and changing that structure simultaneously” (Wodak & Meyer, 2009, p. 7). A commonly used CDA framework proposed by Fairclough (1989) prescribes three stages of critical discourse analysis: *description*, *interpretation*, and *explanation*. At the *description* stage, the text is at the focus of analysis and is examined for lexical features and grammatical choices. At the *interpretation* stage, one is concerned with the process of producing and interpreting the text by discourse participants. The *explanation* stage is concerned with the broader social determinants of production and interpretation of a text. In the context of this study, CDA seemed an appropriate methodological framework to analyze the educational discourse on waste, development and environment from the standpoint of the M(East) ward people.

3.5 Participants

The predominant focus of analysis is on students, science and social science teachers of local schools and the textbooks they followed. To understand the teaching practices for the selected topics and examine teachers’ perspectives on the related subject matter and pedagogical issues, I approached various public and private secondary schools in the M(East) ward. Six science teachers and three social science teachers volunteered to participate in the study. The students were a vital part of the study. I interacted with three different groups of students between the age range of 14 to 18 years. All student

participants came from low-income families in the M(East) ward. At the time of fieldwork, most students were in Grade 9, except a few who had entered Grade 10.

Further, in order to characterize the educational discourse on focal themes, it was important to situate the discourse in the larger context. Also, to explore the possibilities of transformation, it was vital to understand the visions, imaginations and current work of the organizations who have spent considerable time in working in the region for the empowerment of people in the community. Keeping that in mind, I interacted with two groups of rag pickers, one scrap dealer, an engineer associated with a private firm that deals with renewable fuels, the leaders and members of *Kachra Vahatuk Shramik Sangh* (the only trade union of sanitation workers in Mumbai), officials of *SwaCH* (sanitation workers' cooperative operating in Pune), people associated with *Apnalaya* (an NGO working in the M(East) ward with a mission of empowering urban poor) as well as members of the Transforming M-ward project of the *Tata Institute of Social Sciences*.

3.6 Data collection

Most of the fieldwork for this study was done in 2015-2016. The fieldwork for this study followed a 'selective intermittent' time mode as I was selective about the sites and contexts (Jeffrey & Troman, 2004). Field visits were flexible - some were short, some were intense. There were times when I would visit the field on a frequent basis and spend hours in interacting with people, participate in meetings, or roam around the area. At some other times, I would just focus on revising data collection tools, transcribing and interpreting data. Since a major chunk of the fieldwork involved interacting with teachers and students, the classroom observation activity and my interactions with study participants were largely dictated by the academic calendar and their convenience. Interactions with other participants were spread over a few months. The time between field visits allowed me space for reflections, analysis and further planning.

After a few rounds of follow-up, five secondary schools agreed to let me observe teaching practices in their schools and interact with students. Four of them were low-fee private schools, and one was a Municipal Corporation school. I observed classes of six science teachers and three social science teachers. These classes were audio/video recorded depending on the permission we got from the school and the teacher's comfort level with the recording. Classroom observations were supplemented with a critical discourse analysis of the relevant textbook chapters (Chapter on waste and environment in the

science textbook, and the chapter on development in the social science textbook). Wherever possible, I collected artifacts such as students' school project reports, photographs of their science projects, and wall posters in the schools. Some of these reports and projects were related to the themes explored in this study and therefore, complemented my explorations on their perspectives on various matters. Interactions with students were in form of workshops with three different groups of students in out-of-school settings. All these workshops were spread over a week or two, and about 10-15 students participated in each of these workshops (see Table 1).

Table 1 Brief overview of the workshops

	Duration	Participants	Session length	Topics covered
Workshop I	April 2015	No girls, 9 Boys	7 sessions of 90 minutes approx.	Waste, materials, political economy
Workshop II	April 2016	5 Girls, 6 Boys	10 sessions of 90 minutes approx.	Waste, health, development, nature, aspirations, political literacy
Workshop III	July-Aug 2016	9 Girls, 5 Boys	16 sessions of 90 minutes approx.	Waste, health, development, nature, aspirations, political literacy

The basic format of all these workshops was focus group discussion and we discussed various topics ranging from waste, health, development and environment, to their views on government, the problems in the community, the possibilities of change, and their aspirations. The workshop data was video recorded with prior consent of students and their parents.

Part of the fieldwork happened beyond the school walls as well. I participated in a few public gatherings that were called by the civil society to seek solutions of the frequent fire problem at the Deonar dumping ground site. On invitation by one of the leaders of *Kachra Vahatuk Shramik Sangh* (KVSS), I attended a huge gathering of workers at the famous *Azad Maidan* in Mumbai, called by the trade union to put pressure on the government to ensure sanitation workers' wages and other rights. Several workers spoke of their miseries at that public forum. Later I interviewed two sanitation workers and one of the leaders of KVSS. Interactions with *Apnalaya* team members and the TISS M-ward project team members were spread over a few months and were informal in nature. I was part of their everyday activities, and also facilitated sessions for students and teachers associated with these organizations. A short trip to Pune resulted in one-time interaction with an engineer who works in the

waste management area, and the head of the cooperative of sanitation workers – *SwaCH*. All the interviews with participants were audio taped. Fig. 2 encapsulates the gist of the study design.

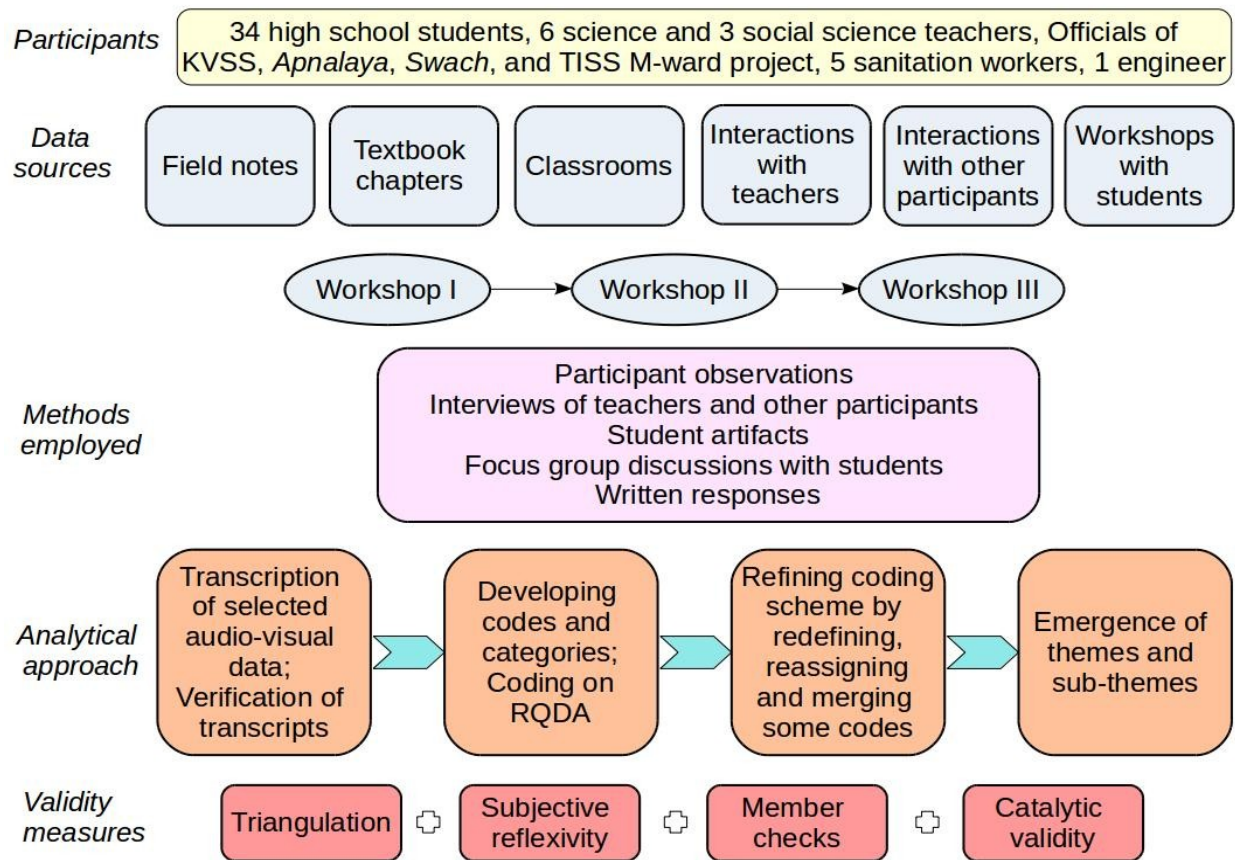


Fig. 2 Study design at a glance

3.7 Analytical approach

The data collected was mostly in the form of audio or video recording except my field notes, the textbooks that I analyzed, and the responses to writing tasks. The selected workshop data (out of a total of 40 hours) and all the interviews were transcribed. After verification, all the transcripts were uploaded on an open source Qualitative Data Analysis software package called RQDA. The broad themes that emerged from the data were superimposed on the textbook chapters to see how aligned those were to the overall organization of textbook chapters. At various stages of analysis, I involved my experienced colleagues as well who themselves have conducted qualitative studies. They helped me decide the subsequent steps of analysis. The coding scheme also greatly benefited from their inputs.

Establishing trustworthiness and credibility of data is a major challenge in any qualitative research. Lather (1986) argues that validity in the context of openly ideological research needs to be reconceptualized to ensure rigor while creating space for subjectivity and reflexivity. In a theoretically guided, unabashedly ideological research, there is always a risk of ‘conceptual overdeterminism’ and a ‘systematized reflexivity’ on researchers’ part could help in overcoming any theoretical imposition. The role of empirical data is crucial in making a claim and I have extensively relied on the data collected through various sources and methods to make my argument. Data for this study was collected through multiple sources (students, teachers, textbooks, activists, sanitation workers and rag pickers) and by employing diverse methods (field notes, interviews, classroom observations, focus group discussions, as well as writing tasks). Another criterion to enhance data credibility is through member checks. In the context of this study, I kept rewording what my respondents uttered during my interactions with them, and crosschecked with them if I have understood them right. If they disagreed with my interpretation, I would ask them to clarify their position.

One of the key validity criteria in a critical ethnography is ‘catalytic validity’ i.e. to what extent the research facilitates participants’ *conscientization*, helps them reflect on their lived realities, and leads to activism (individual / collective action). A critical ethnographer not just documents the reality but also aims to ‘educate’ the research participants and facilitate the process of gaining self-understanding and enhancing self-determination in the struggle towards social justice. In my interactions with students, I used a few tasks which did make student participants reflect on their living conditions (e.g. housing, health, and sanitation). Engagement in activism was not possible within the scope of the study.

Chapter 4: Discourse on waste

The focus of this chapter is to critically analyze the educational discourse on waste, and problematize it against the lived experiences and everyday knowledge of the students of the M(East) ward. In particular, I explore how the educational discourse on waste is positioned vis-à-vis the concerns, experiences, and out-of-school knowledge of the students of the M(East) ward (Srivastava, Gupta & Raveedran, 2021).

4.1 Waste: a complex terrain

Waste is one of the distinguishing features of human society. Across the globe, it is acknowledged as a serious environmental problem. Doron & Jeffrey (2018) argue that what makes the problem of waste in India unique is its enormous volume and the nature of waste piling up at various landfill sites in the country. Moreover, most of the unattended waste at the landfill sites is mixed and therefore, its processing or material recovery is next to impossible.

In Mumbai, following a private-public partnership model, the municipal corporation works in close alliance with the private lobby for waste management in the city. Though contracts are awarded for waste collection as well as waste processing for each landfill site, the private contractors focus only on waste collection and blatantly ignore the processing part of the contract. The corruption in the government system enables the private lobby to operate smoothly. The government pays the contractors based on the amount of waste collected. Their lorries ply through the city day and night and dump the collected waste at their assigned landfill sites. The more waste they dump, the more they are paid by the government. The contractors, therefore, use all possible means to maximize the collected waste. As a result, waste continues to accumulate at the three landfill sites in Mumbai. Since most waste collected by the municipal corporation in collaboration with private contractors is left unsegregated, unprocessed and unattended at the landfills, a local mafia monopolizes and closely regulates access to the landfill. The rotting waste at the landfills not only affects the health of the people who live in the close vicinity, but also poses severe health risks to those who are dependent on waste for their livelihoods.

The interlinkages between waste and caste

In India, the notions of waste, dirt and filth are closely tied up with the ideas of purity and pollution. The cultural anthropologist, Mary Douglas argues that the rules of purity and pollution vary from culture to culture with what is considered pure and impure being a matter of customs and beliefs. In the Indian context, this notion manifests itself in the context of 'caste pollution', which is a "symbolic system, based on the image of the body, whose primary concern is the ordering of a social hierarchy" (Douglas, 2003, p. 126). Doron & Jeffrey (2018) note that in India "attitudes about ritual purity and pollution often collide with scientific understanding of waste and dirt and of sanitation and hygiene" (p. 2).

The waste workers as well as those who live near the dumping sites live in conditions that pose a high degree of risk to their health and yet are discriminated against by the other sections of society. Rag pickers and sanitation workers are also prone to accidents and injuries during work. They suffer a much greater impact than those who detach themselves from the waste chain after disposing of their waste in designated bins. The unequal exposure to pollution, toxics, health risks and occupational hazards that the Dalit Bahujans and lower-caste Muslims of the M(East) ward confront everyday as part of their job is similar to the experiences of people of color in the Global North who bear the brunt of the treadmill of production and what has been recognized by scholars as manifestation of ‘environmental racism’ (Pellow, 2004). In the Indian context, Lee (2017) calls this phenomenon ‘environmental casteism’.

The elephant in the room: the political economy of consumption

There is no dearth of explanations for who is responsible for aggravating the waste problem. While Marxist scholars locate the roots of the growing problem of waste management in the technoscientific model of development, profit-oriented capitalist economy, and the resultant consumerist tendencies prevailing in society, many others argue that overpopulation and people's attitude toward the environment is the root cause of the problem. Describing overpopulation as the primary reason for the waste problem is to ignore the disproportionate, excessive consumption patterns of the elite class. In a country where most people barely have a livelihood, it is important to stop blaming individuals for their changing lifestyles and their attitudes towards the environment and consumption. Although consumption practices need to be questioned, there is also a limit to how much individuals be blamed for their actions when consumer goods are designed by companies to have a short shelf-life (planned obsolescence), and consumers are made to believe that their goods are no longer in vogue (perceived obsolescence). Repair and reuse have also ceased to become attractive philosophies in the fast-paced economy.

4.2 Educational discourse on waste

With consumerism and wastefulness being a major part of today's lifestyle, waste management has become a pressing problem for most countries. However, it is surprising that waste remains an under-explored area in educational research. The reason for the paucity of research on waste education, I speculate, is possibly because it is still perceived as a problem of the developing countries. Moreover, most of the empirical work available in the area focuses on the interplay of knowledge, values and

attitudes. Social, political and economic contexts of waste remain largely uncharted in educational research.

In order to understand the nature of educational discourse and the underlying ideological commitment, I analyzed the chapter on waste from the Maharashtra state Grade IX textbook, and the classroom practices of a few teachers when they taught this topic, and did follow-up interviews with the teachers. Further, in an ‘oppositional’ reading of the educational discourse I explored three broad themes – 1) how waste is defined and what reasons are provided for the large scale generation of waste, its accumulation and improper management (henceforth, referred to as the ‘waste problem’), 2) what effects of waste on the natural environment and human life are emphasized, and 3) what measures are suggested to overcome the problem.

The findings indicate that the textbook and the classroom practices deal with the problem of waste in a techno-managerial manner with a focus on teaching how to *manage* waste through scientific methods. Moreover, overpopulation, mismanagement, lack of political will and people’s attitudes are offered as explanations for the aggravating waste problem, while the connections between the generation of waste, consumerism and the nature of economic growth are sidelined by the textbook as well as the teachers in their classroom discourse. I argue that discussing the political economy of waste generation with the M(East) ward students is important for the students to go beyond explanations that implicate their communities and their behavioral practices for the burgeoning waste problem.

This brings us to another important insight that emerged in my analysis - the class and caste character of the educational discourse around waste. A middle class, upper caste audience is assumed in many of the examples and activities of the textbook. For instance, aesthetic effects of improper waste management are privileged over the impact of waste on people’s health and the natural environment, which is consistent with a ‘bourgeois environmentalist’ standpoint that reflects a “... concern with an ordered environment, that is safe, hygienic, unpolluted, green and uncongested, (which) is in some ways an extension of the concern about bodily well-being” (Baviskar, 2002). The pro-environmental behaviors that are promoted by the textbook, ranging from waste segregation to composting and reducing specific consumption practices, also assume a middle class audience since it takes for granted the readers’ access to resources like a backyard or dustbins to segregate waste or money to spend on consumer goods. A critical examination of the prescribed pro-environmental practices from the standpoint of the students of the M(East) ward shows that their community’s immense contribution to

easing the environmental burden through their livelihood, not merely personal actions and behaviors, remains unacknowledged. In other words, the people who deal with waste on an everyday basis or live close to landfill sites do not become subjects in or subjects of the textbook, let alone a discussion of their social locations or the caste character of sanitation work. The textbook's approach to waste is, ironically, sanitized.

It is partly the placement of the topic of waste in the science textbook that makes its sanitized and reductive/ techno-managerial treatment possible. The hegemonic discourse that maintains the dichotomy of facts and values enables powerful interest groups driving the institutions of science and science education to construct boundaries around acceptable political ideologies in the science curriculum (Raveendran & Chunawala, 2015). Even the choice of science content around waste reveals these tendencies. For instance, the discussion of the waste processing industries downplays risks and threats that they pose to local livelihoods and unveils propensities within the discourse to protect corporate interests. That said, the discussion of risks incurred by highly polluting industries and the health effects does raise ethical dilemmas for educators working with the urban poor. In other words, how does the environmental risk discourse serve a student whose community is dependent on 'risky' work? How does one engage in a responsible and productive discussion around risk with students from marginalised communities? It is important for educators to be conscious of what 'science content' is meaningful for the students and what ideological positions drive the selection of the science content.

What then would be relevant 'science content' for children of the community? Let us begin with the scientific categorization of waste into 'dry' and 'wet' categories. As demonstrated in the results, the terminology is itself counter-intuitive to both teachers and students and these categories do not have any relevance unless students understand what biodegradability means. The waste accumulating in the landfill site is also of an unsegregated nature. Educational interventions could focus on initiating community-level composting and engage students with the science of biodegradation. They can explore topics such as the rate at which different materials degrade in nature, the conditions that favor composting, the role played by microbes in decomposition of matter, what gases are produced if waste is left to rot, and how to detect the presence of these gases. Other possible lines of inquiry are why there is a high prevalence of diseases like tuberculosis, typhoid or malaria in the M(East) ward, how to safely extract materials from garbage piles, and how are various materials recycled. My analysis reveals that teachers were also ill-equipped to deal with concerns that affect the community.

Beyond the disciplinary politics of science education, in India, the centralized system of textbook production and dissemination militates against meaningful and contextualized learning. Therefore, as long as the teachers are not free to choose their own teaching material, they would be confronted with the daunting task of contextualising the textbook matter. Moreover, transacting the chapter on waste would require an ‘oppositional’ reading of the textbook by teachers, since the textbook chapter, as discussed, is nowhere close to acknowledging, let alone engaging with the lived realities of the people as in the M(East) ward. However, my classroom observations reveal that the textbook largely structured the classroom practices of the teachers, reflecting a ‘dominant’ or ‘negotiated’ reading of the textbook on the part of the teachers (Apple, 1992).

The teachers’ efforts in their pedagogical spaces to contextualize the subject matter and connect to students’ life worlds were limited. For instance, none of the teachers referred to the local incinerator or the informal recycling industry flourishing in the neighborhood. I speculate that since most of the teachers did not hail from communities that live close to the landfill, they lacked empathy for the concerns faced by the community. When asked to respond to the civil society’s suggestion of permanently shutting the Deonar dumping site, the teachers forthrightly endorsed the proposal. In their defense, they repeated the textbook argument that a landfill should at least be two kilometers away from human settlements. The consequent loss of livelihoods of thousands of rag pickers and scrap dealers from the community whose survival is entirely dependent on the landfill was not given any consideration.

The out-of-school interactions with the students from the community reveal that the students had a rich understanding of the recycling economy, and that their concerns and questions were way different from a typical middle class student. In the informal interactions, the students also offered their ‘dark’ funds of knowledge (Zipin, 2009), when they shared stories of crime, violence, substance abuse, sexual harassment at public places and the discriminatory behaviour of police towards their community. However, the educational discourse around waste does not allow any space for students to share their experiences, concerns, questions or knowledge, and seems to be working merely as an instrument of *symbolic violence* (Bourdieu & Passeron, 1977).

Chapter 5: Discourse on environment and development

This chapter pays attention to two broader themes – environment and development – which are intrinsically linked to the topic of ‘waste’. The main question that I aim to address in this chapter is – *How is the educational discourse on development and environment positioned vis-à-vis the concerns, experiences, and out-of-school knowledge of the students of the M(East) ward?* I begin with examining the dominant discourse on development and environment in the Indian sub-continent which sets the context for analyzing the educational discourse on these topics. The analysis of the educational discourse involved a critical examination of both science and social science textbooks that are followed in the schools of the M(East) ward, classroom teaching of topics related to environment and development, and formal and informal interactions with teachers and students of the M(East) ward.

5.1 Dominant discourse on environment and development

The idea of nature and the human-nature relationship are at the core of any discourse on environment and environmental problems. Different environmental philosophies hold different positions on these matters (Haydock & Srivastava, 2019) resulting in a whole range of discourses on nature existing simultaneously. For instance, a scientific reading of nature assumes uniformity in nature that “allows experiments to be repeated... (and) make(s) scientists search for universal structures and universal laws” (Sarukkai, 2012, p. 23). Another assumption that science makes about nature is that it is mute and inanimate, and it does not reveal its secrets on its own. The truth needs to be discovered through the scientific method. In their description of scientific method, earlier philosophers of science have often invoked metaphors of violence. For instance, Francis Bacon, a major proponent of the scientific method during the times of scientific revolution in Europe, held that man is superior to nature, and man must “conquer”, “subjugate”, and “tame” nature in order to study it and build his empire. This kind of androcentrism has dominated the discourse on nature in sciences for a long period of time. Nevertheless, the environment and feminist movements of the previous century have radically questioned and challenged these views on nature.

In popular imagination as well as in the discourse of conservationists, nature is often associated with the notion of “wilderness” that needs to be preserved for its own sake. Environmental philosophies such as Gandhian ideology, deep ecology, certain forms of ecofeminism, and ecospiritualism assign

divinity to nature, make references to the idea of balance of nature, and explain the global environmental crisis in terms of the rupture of the balance for diverse reasons (Haydock & Srivastava, 2019). These philosophies have also been critiqued for their caste character since they seem to justify the hierarchical caste structure and employ the purity-pollution discourse (Sharma, 2017). Another view on nature that dominates recent policy documents across the globe is driven by the logic of market and conceptualizes nature in terms of a pool of 'resources' needed to be used 'efficiently' and 'managed' properly.

In the developed countries, the alarm over dwindling natural resources and the necessity to restrain economic growth first appeared in the 1970s with the publication of the report 'Limits to Growth' in 1972. The same year, the United Nations Conference on the Human Environment in Stockholm discussed environment and development as interlinked concepts. This conference was pivotal in launching the Anthropocene discourse which argues that the economic growth need not necessarily lead to environmental destruction (D'Souza, 2012). The 1970s also witnessed the emergence of modern environmentalism in the western world with the publication of Rachel Carson's *Silent Spring*. The term 'sustainable development' was eventually introduced in 1987, in the report, *Our Common Future*, also known as the Brundtland report (D'Souza, 2012; Kothari, 2014).

The Indian government policy responded to these developments in the West, evident in the discursive shifts in the understanding of nature and economic growth from the first to the fifth five-year plan document. While the first five-year plan document of independent India discusses both nature and human beings in terms of untapped potential, the notion of resource scarcity and the necessity to acknowledge environmental degradation and pollution are discernible in the fifth plan document (D'Souza, 2012). The shift in the discourse on nature and economic growth parallels a broader global discursive shift in the understanding of development, conceptualized only in terms of economic growth in the 1800s to an understanding of development as growth that is inclusive of social and environmental indicators in the mid-1990s (Achuthan, 2011).

In post-colonial India, one finds multiple discourses on development competing with each other. These discourses can be understood in relation to the visions of three nationalist leaders - Jawaharlal Nehru, M K Gandhi, and B R Ambedkar. The development model adopted by the Indian state post-independence was inspired by Nehru's scientific socialism. According to this model, controlled economic growth under a socialist state, bolstered by technoscience based development projects, would

be the way to save a country struggling to overcome poverty, ill-health, and overpopulation. On the other hand, Gandhi had an entirely different vision of development that sought to sustain rural livelihoods, opposed big deskilling technology and industrialization, and emphasized decentralized economic activity of the village *panchayats* (local self-governance system set up at the village level) that are unregulated by the state. Ambedkar, a scholar, anti-caste leader, and the architect of the Indian constitution, emphasized the necessity of state-protected industrialization (Robinson, 2014) as he staunchly believed that industrialization, through the provision of employment opportunities, would put an end to caste-based economic feudal relations prevalent in the primarily agrarian Indian society (Shivaprasad, 2016).

However, despite these diverse visions, the Nehruvian idea of scientific socialism won out when Jawaharlal Nehru took over as the first prime minister of independent India. Big technoscientific development projects such as atomic energy ventures of the 1950s, the green revolution of the 60s and 70s, and the white revolution of dairy technologies of the 70s and 80s were instituted. In these decades, however, people's movements also began to raise critical questions on these technoscientific development projects such as who they benefit and who they leave behind. For instance, the *Narmada Bachao Aandolan* (Save Narmada Movement) of the 1980s was a social movement against the Sardar Sarovar Dam, a product of the Nehruvian imagination of technoscientific development, raising concerns about widespread ecological destruction as well as displacement of the marginalized people who lived near the project site². Thus, the people's movements directly raised critical questions on development – development for whom and at what cost. In other words, while international and national policy documents celebrated the dominant discourse of sustainable development, people's movements in India through the 70s and 80s stressed the political nature of environmental issues, seeking to politicize the notion of development, raising questions on conventional models of economic growth.

Since the 1990s, with liberalization, the Indian economy opened up to foreign investment, heralding the integration of the Indian economy with the global economy. Concomitantly, the state has also receded from investing in essential welfare services such as health and education, resulting in the increased privatization of these sectors. At present, the Indian government has implemented a series of revisions

² It also has to be pointed out that some scholarly works (reviewed in Sharma, 2017) have critiqued the NBA for being exclusive of concerns related to landless, marginalised groups, especially dalits.

in the environmental laws that safeguard business interests at the cost of displacing the indigenous communities that depend on the forests for survival and livelihood (Aggarwal, 2019).

In academia, the 1990s also witnessed the emergence of the post-development (PD) discourses (Escobar, 2011). Drawing on post-structuralist theorists such as Foucault, proponents of PD discourses argue that development and its associated terminology need to be understood as a dominant discourse. This discourse which has emerged in the Global North, defines, limits, exploits, and dispossesses the people of the Global South. However, critics of the post-development discourse argue that it is important not to view development as a monolithic, all-powerful entity. There have been ways in which human agency in the Global South has resisted the development discourse through “local re-imaginings, alternative voices, and different worldviews” (D’Souza, 2012).

The dominant, state-backed model of sustainable development holds different implications for different people. While for the privileged, it may signify progress and prosperity; for the marginalized, development projects have led to displacement and loss of livelihoods and ways of being. In other words, development, in the sense of unfettered economic growth, comes at a huge cost to be paid by people whose livelihoods and lives are linked to their local environments.

5.2 Educational discourse on environment and development

The focus of this chapter is to characterize the educational discourse on environment and development. In order to identify potential pedagogical resources in students’ lifeworlds, I juxtaposed this discourse against the students’ everyday discourses on these matters. This part of the study involved a critical discourse analysis of – 1) two relevant textbook chapters (*Bonding with ecosystems* in the science textbook, and *Regional development* in the social science textbook), 2) classroom practices of three science teachers and three social science teachers when they taught those chapters, 3) their views expressed in their interviews, and 4) the participant students’ understanding of development and environment which they shared in our interactions with them in out-of-school settings.

In my analysis, I have tried to cover all major ideas discussed in the two textbook chapters. I begin with a discussion on how nature is portrayed in the educational discourse i.e. what language is used to talk about nature, and how the relationship between humans and nature is portrayed. This is followed by a discussion on the understanding of development where I examine how development is defined in the

textbook chapters, what markers of development are discussed, and how the difference between GDP and HDI is explained. Next I discuss the regional variation in development – what variations are highlighted in the discourse and what variations are ignored, and what kinds of explanations are offered for the regional imbalance in development. Finally, I discuss the conflicts around development projects because an engagement with various aspects of real development projects reveals the complexity of the topic to the learners. The issues related to social and environmental justice are brought into sharp relief when controversial projects are debated in the public domain.

The findings indicate that the science and social science textbooks conceptualize nature in slightly different ways. While the science textbook adopts a technical approach to discuss ecosystems and the interconnections between humans and nature, the social science textbook portrays nature merely as a pool of resources. At times, both textbooks employ a utilitarian language to discuss nature. The science textbook also emphasizes the need for nature's mechanism of maintaining a balance which is a contentious idea. However, apart from the scientific tenability of the balance of nature argument, it also needs to be argued that the discourse on balance of nature and the role of human beings in maintaining this balance places humans outside nature invoking a binary between humans and nature, while the relationship is a deeply enmeshed one. The livelihoods of the marginalized groups in the Indian society are closely tied up with land, water and the forests (Sharma, 2017). The educational discourse which indiscriminately puts the onus of maintaining the balance of nature on people, seems insensitive to the lived realities of the marginalized groups who barely manage to procure resources for sustenance.

Notably, while discussing human-nature interdependence, most participant students could not think of how nature is dependent on humans, and I speculate that it might have to do with their socioeconomic conditions. Residing next to the city's garbage mountain, they seemed more concerned about how they were getting affected by their surrounding environment, and not so much about how they would be affecting their environment.

When conversing about nature and human-nature relationship, most participant students referred to religious scriptures such as the *Quran* and invoked an anthropocentric stance in their arguments. They seemed to believe that nature was created to serve humans. Such beliefs conflict with an ecological understanding of the human-nature interdependence as well as a holistic stance propagated in several Islamic texts including the *Quran*. For instance, discussing environmental ethics in Islam, Kamla et al. (2006) point out *Tawheed* (Unity of God) to be one of the key guiding principles in Islam.

The concept (*Tawheed*) implies the unity and equality of all God's creations in the worship of God and their equality as partners in terms of the due respectful recognition of the existence of all and the due appreciation of interdependency and interconnectedness between all... There is thus an equilibrium ruling the natural world, and all God's creations are understood to be in balance or in harmony in this respect, having been created in a measured way or by measure, a measure not to exceed or to fall short of (Kamla et al., 2006, p. 249).

They argue that "Islam extends its concerns beyond an anthropocentric focus, towards the well-being or balance of the ecosystem and general flora and fauna" (p. 254). Obsessive extravagance (*Israf*), excessive consumerism, conspicuous consumption and waste generation are seen in negative light in Islam. Thus, it is important that such values are emphasized even in religious education.

On the question of rights of living beings over natural resources, most students seemed to take an egalitarian approach and argued that everyone has equal rights over water, air or land. When probed further on limited and differential access to water in their homes, they tried to explain it in terms of overpopulation, the will of the controlling authorities, amount of rain in an year, or logistical problems in distribution but did not connect it with their socioeconomic status.

In the context of development, it is notable that the ideology of sustainable development dominates recent curriculum documents in India (NCERT, 2006a). The analysis of a chapter on regional development and related classroom teaching practices interestingly shows that development is discussed in a holistic sense and not merely in terms of economic growth. However, any kind of conflict related to these issues is avoided in the curriculum and the content is presented in an apolitical manner. For instance, the social science textbook explains the regional variation in development levels merely in terms of geographical factors and people's willingness to utilize resources, while the complexities and conflicts around development do not get any mention.

In my interactions with the students and teachers, I observed that both the groups (teachers and students) had a nuanced understanding of development. They not only explained the ward-wise variation in terms of sociopolitical factors but also demonstrated an awareness of the role of state and industry in determining the fate of people's livelihoods and the environment. They did not advocate unfettered economic growth rather they seemed concerned about those who suffer the consequences of big development projects. For instance, while discussing the story of a steel plant, most participant

students were empathetic towards the other marginalized groups (tribal communities) expressing concern for their livelihoods despite having very little knowledge about the lives of these communities. Perhaps their own experiences had made them sensitive to issues related to displacement, violation of rights of local people, complexities of rehabilitation, and the absurdity of sacrifice in the name of larger good. A few students also raised environmental concerns in this context. Since most students did not express broader sustainability concerns during this discussion, I wonder if it is because their imaginations are shaped by the pressures of their lived realities where day-to-day struggles for livelihood are prominent.

While discussing levels of development and the regional variation in development, the teachers seemed to be making an attempt to contextualize the subject matter. However, these efforts were limited in scope and the students did not engage much with those examples. Still, I believe that these little efforts on the part of the teachers to simplify and contextualize the content for their students need to be acknowledged, appreciated, and supported through well-designed professional development courses. As part of their professional development, teachers must get an opportunity to learn about which examples and strategies work better in a particular context.

Another important question that concerns me is how to deal with the cultural beliefs of those students who come from marginalized backgrounds if those beliefs are not in agreement with the ones that science educators seek to propagate. Since science and religion are often presented as incompatible or incommensurable knowledge systems that are in conflict with each other, I wonder how critical science educators could help students make sense of the scientific discourse on nature without discarding their cultural beliefs that advocate an anthropocentric position. Jegede & Aikenhead (1999) elaborate how science learning could be an alienating experience for students whose lifeworlds are at odds with the culture of science.

Respecting cultural beliefs of marginalized groups and accommodating them in science classrooms is a major challenge for science educators committed to social and environmental justice. Shedding some light on how to go about helping students navigate the two apparently contradictory discourses, Southerland & Scharmann (2013) argue that “an equitable approach to science education must also be cognizant of students’ religious beliefs” (p. 64). They suggest that science should be presented as one of the ways of knowing, and not the ultimate way of knowing the world. Students should learn that there is no implied hierarchy to these ways of knowing. In order to help students reconcile the conflict

between scientific and religious beliefs on matters, they advocate an “early, explicit consideration of the nature of scientific knowledge with a particular focus on the boundaries of science” (p. 64) i.e. what questions come under the purview of science, what methods are employed for knowledge construction and validation in science, and what are the overlaps and differences among various knowledge systems.

An alternative model of science and environment education committed to principles of social and environmental justice must engage with onto-epistemologies of science and everyday knowledge. How to help learners resolve the conflict between the two discourses without undervaluing their cultural identities remains a big challenge for critical science and environment educators.

Chapter 6: Towards a justice-centered science and environment education

The analysis of the formal educational discourse on selected themes reveals a decontextualized, depoliticized character of the discourse. Moreover, by not providing any space for their voices and concerns on an issue so central to their lives, the curriculum exerts ‘symbolic violence’ on the students, and can certainly not be seen as an empowering experience for the M(East) ward community. The out-of-school interactions with students provided me an opportunity to know them as individuals, understand their daily struggles, their concerns, their aspirations as well as explore the knowledge they have constructed as part of their social upbringing. This everyday knowledge is not valued by the school curriculum and students often remain conflicted about its validity. I imagine a space where there is a possibility of dialogue between the educational discourse and students’ everyday discourses. This is where I see my ideas resonating with what scholars have called a ‘hybrid’ space of learning. I elaborate these ideas in this chapter and then, turn my focus to another objective of the thesis and offer an integrated, contextually-relevant, and justice-centered alternative in the context of waste as a theme.

6.1 Exploring students’ life worlds

Since the world of school does not offer an empowering experience to the M(East) ward students, there is a dire need to formulate a contextualized alternative that the students can connect with. The first step in that direction would be to explore the world outside school that the students have access to, and

understand their life worlds – in particular, their lived experiences, knowledge, values, aspirations, cultural beliefs, and political views. Another key objective of the study, therefore, was to explore the life worlds of the participant students. The three workshops with the students provided ample opportunities to elicit their lived experiences as well as their views in the context of the focal themes (Fig. 3).

Self-reports of the students indicate that their families lacked access to basic amenities like adequate healthcare facilities, nutritious food, potable water, toilets as well as public hygiene which are crucial for people's health (Srivastava, Khan & Raveendran, 2018). When presented with context-specific vignettes, students demonstrated thorough understanding of the complex linkages between health, hygiene, nutrition, access to healthcare, and poverty. Their rich understanding of the social determinants of health could only be attributed to their individual as well as collective struggle for basic amenities on an everyday basis as the main focus of the textbook chapter on health is to promote a technical understanding of common diseases in terms of symptoms, causes and methods of cure. Yet students' understanding of various diseases in terms of their causes and remedies was found to be inadequate. This indicates how disconnected the formal school curriculum is from the lives of these learners.

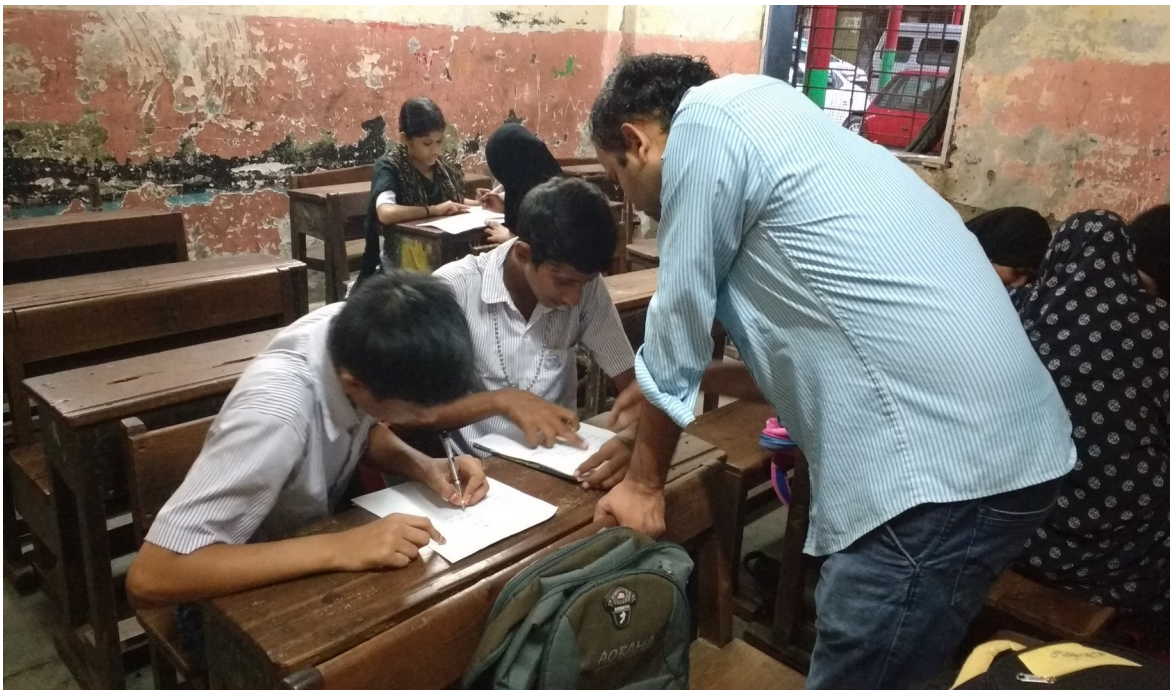


Fig. 3 Students responding to a worksheet in a workshop

In the context of the discussion on waste, the out-of-school interactions revealed that the students had a rich understanding of the recycling economy especially on recycling value, and the extraction and recycling processes of various materials. With regard to the environment-development debate, they manifested a nuanced understanding of development and explained the local variation in development indicators in terms of sociopolitical factors. They also demonstrated an awareness of the role of state and industry in determining the fate of people's livelihoods and the environment. However, as one would expect, their political views were not consistent or stable.

While discussing the story of a steel plant, most students showed empathy towards tribal communities that would be displaced and expressed concern for their livelihoods despite having very little knowledge about their lives. In the discussion on health, students brought into their discussions references to alternative medical practices that existed in the community which include prayer, black magic and home remedies. Similarly, when conversing about nature and human-nature relationship, most participant students referred to religious scriptures such as *Quran* and invoked an anthropocentric stance in their arguments.

A fictional story 'Elections in a jungle' helped us venture into their political views. They were agitated by the government's discriminatory actions against the Muslim community in the country. In the context of the animation film 'Story of Stuff' that we watched together in one of the workshops, the students pointed out a major facet of the current political economy i.e. the nexus between the government and the industry, how they serve each other's interests, and how they exploit common people. I also wrote a poem titled 'Ek chuze ka khwab' to elicit participants' understanding of the sociopolitical problems they face. The discussion on the poem helped us explore what they think of as the big problems in their locality, how strongly they feel for addressing those problems, and what they aspire to do in the future. In that context, most students expressed interest in doing something for the betterment of their community in addition to pursuing their specific professional interests.

These planned and unplanned explorations into students' life worlds brought to the fore not only their rich experiences, values, knowledge, concerns, cultural beliefs, political views, but also a medley of emotions such as shame, agitation, and more importantly, undaunted hope that the situation can be changed. These cognitive, affective and sociocultural aspects of their life worlds are shaped by their interactions in their families, peer group, community, and popular culture, and are known to have great potential as pedagogical resources. These resources are socially distributed, accumulated over time, and

strategically employed by individuals and communities for survival and well being. Moll et al. (1992) define these “historically accumulated and culturally developed bodies of knowledge and skills essential for household or individual functioning and well-being” as ‘Funds of Knowledge’ (p. 133).

It is striking that while prevalent deficit discourses explain the underachievement of minority students in terms of deficiencies lying with students, their families and their cultures, the funds of knowledge perspective turns the deficit-theorizing upside down by acknowledging and valuing the rich tradition of knowledge and values owned by marginalized communities. Moreover, students’ funds of knowledge can be harnessed towards effective school learning by redesigning the curriculum around the knowledge that communities possess. Inclusion of funds of knowledge also makes learning more accessible for students from marginalized communities as they find familiar starting points.

Zipin (2009) calls attention to students’ dark funds of knowledge which include prior bad experiences such as bullying, alcoholism, harassment and discrimination. Recognition of students’ dark funds of knowledge can bring about stronger life world connections, turn them into learning assets, and thus can also be potentially empowering and transformative for students. When invoked in a learning context, the dark funds of knowledge trigger a feeling of discomfort among students as well as teachers but also generate high student participation and provide opportunities to converse on things that matter to students.

If teachers direct their focus on exploring students’ funds of knowledge and Discourses, bring it up for discussion in their classrooms and value that as a learning resource, they would be enabling a learning environment for minority students and scaffolding their learning. However, often the school curriculum discredits what students know from their everyday experiences. Thus, it is important that a space is created which provides affordance for dialogue between the academic and everyday discourses. Drawing upon scholarship in various fields, Moje et al. (2004) make a case for conceptualizing a ‘hybrid space’ of learning and offer three distinct meanings of the concept: 1) Hybrid space as a *scaffold* that links marginalized funds of knowledge and Discourses to academic funds and Discourses to ensure better academic achievement and success in the conventional sense; 2) Hybrid space as a *navigational space* in gaining competency and expertise to negotiate different discourse communities, and in the process generate new knowledges and Discourses; and 3) Hybrid space as a *space of cultural, social, and epistemological exchange* where competing funds and Discourses coalesce into each other. Everyday knowledges and Discourses are integrated with disciplinary learning in ways that

challenge, destabilize and eventually expand the boundaries of official Discourse. In the next section, I build upon these ideas and aim to offer a way forward.

6.2 A way forward

Having developed a systematic critique of the educational discourse on focal themes and having explored students' life worlds for pedagogical resources, I aim to delineate a plausible model of justice-centered science and environment education in the context of the M(East) ward. I have chosen 'waste' as a theme to illustrate how an interdisciplinary theme could be developed in a justice-centered framework though during our interactions with students, I felt 'water' could also have been an interesting theme to explore in that context as most students seemed to relate to that issue.

As discussed earlier, waste is a theme that is closely connected to various other curricular topics such as health, materials, environment, and development. Also, there are several dimensions to the topic (e.g. technoscientific, sociocultural, economic, political, historical, and ethical), that need to be explored to get a comprehensive picture of the topic (Fig. 4). Thus, the topic can be unpacked at several levels, and there need not be any particular order in exploring various dimensions of waste as they are all interlinked. However, at every level, one must ask whether this particular topic or this particular way of teaching helps achieve a more equal, just, and sustainable world.

In a classroom context, unraveling the idea of waste with students could include technical discussions around what qualifies as waste, various categorizations used to understand waste, the scale and nature of waste, the reasons behind waste generation at such a large scale, environment-friendly practices of managing waste, impacts of waste on people as well as the natural environment, and the connections between waste and health. Based on my interactions with the students, below I discuss a few discussion points, resources, and activities that the students can be engaged with. Some of these ideas have been tried out by other researchers and teachers in their respective contexts and some I have tried myself in the workshop context. This part is divided into three sub-themes: a) Understanding waste, b) Understanding impacts of waste on people and the natural environment, and c) Exploring solutions.

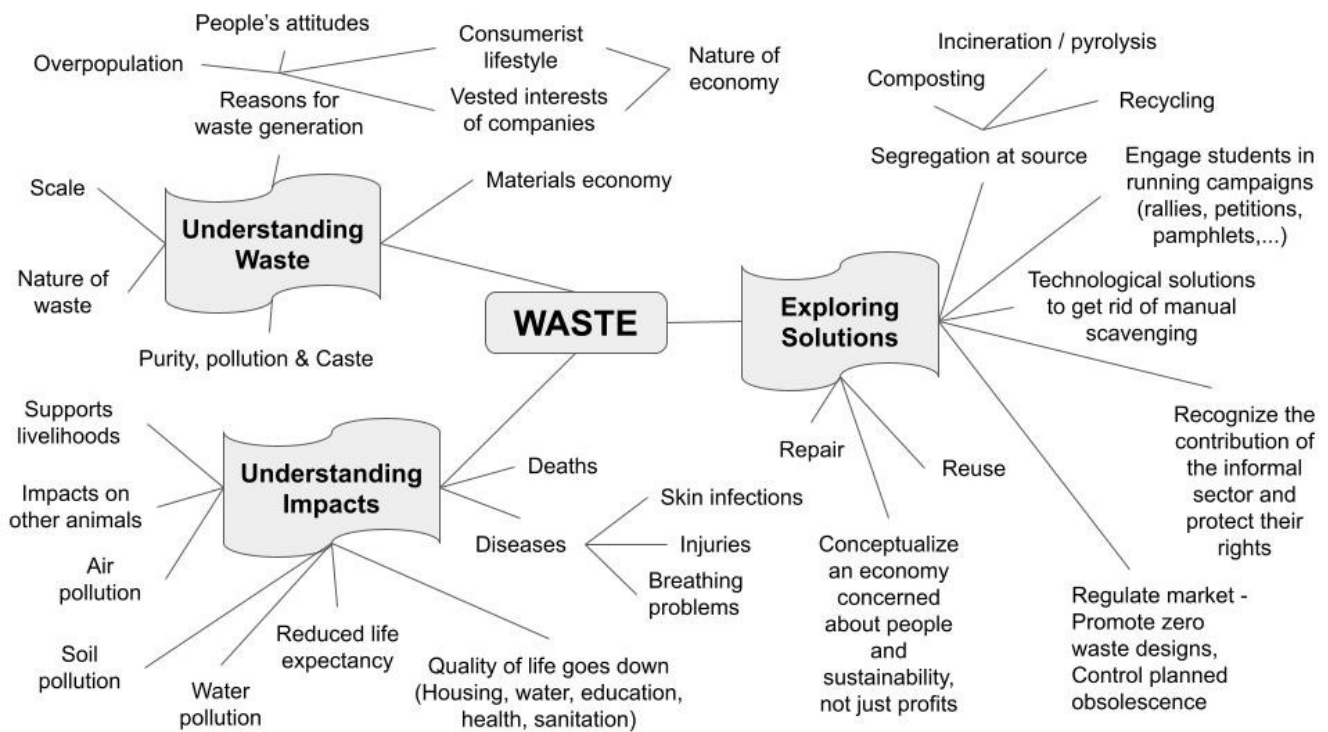


Fig. 4 Interconnections of various sub-themes related to waste

A) Understanding waste

Understanding waste would include the enormous scale and the nature of waste produced in cities, reasons for large-scale waste generation, materials economy, as well as the connection between purity, pollution and caste.

Students can write or draw an incident or narrate an experience related to the dumping ground. When this exercise was given to students in the workshop context, it revealed how closely and critically students observed and engaged with that physical and social space. To initiate a discussion on the scale of waste that is being produced in cities, I had used a poster (Fig. 5) to generate a discussion with the students on the enormous scale at which Mumbai is generating waste and a large proportion of that waste is being dumped in their backyards. Earlier some students had expressed that the waste lying at the Deonar dumping ground was their own and blamed their community for producing waste at that scale. Students can also be encouraged to conduct a waste audit for their households.

An exercise in which students had to write autobiographies of an object (for example, a pen, a pair of shoes, a water bottle, or a book) resulted in detailed stories about the life cycles of those objects and in particular, how they are disposed of once they run out of use. Similar exercise can be used to elicit students' understanding of the materials economy. Interestingly, the categorization game that I had designed for students to play during out-of-school interactions could not elicit the categories that rag pickers commonly use to sort waste. In this game, various objects of daily use are kept in front of the class, and the class is divided into two groups. One group randomly selects an object from the pile, and the second group has to guess the item that the other team has thought of by asking questions that can be answered only in Yes or No. The team that can guess the selected item in fewer questions wins the game. The participants employed four different categories during the game: a) utility of those items, b) frequency of usage (daily vs occasional), c) source (directly received from nature vs man-made), and d) the material it is made of. Recyclability or recycle value of a particular item did not appear as a criterion in that conversation. Perhaps the participants themselves were not closely involved in recycling business.

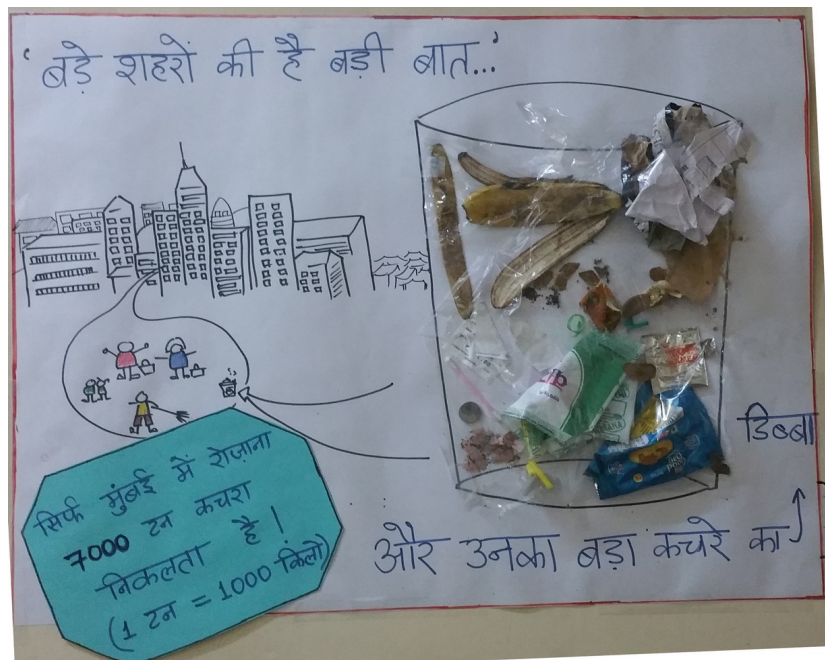


Fig. 5 Poster used to discuss the enormous scale of waste generated in Mumbai

To understand sociocultural and political dimensions of the issue, students can do a survey and prepare a socioeconomic profile of the people involved in sanitation work which would help them understand the casteist and gendered nature of the work. They should discuss in the class why only certain castes are involved in sanitation work and how that can be changed. The political economy of waste also needs to be unpacked as students learn about waste. They must engage with questions like how various commodities come into being, which involves asking where and how various things are produced, sold, consumed, and disposed of, who are the people involved at various stages of production, whose interests are served and who is at a loss in the whole production-consumption process. I had used an

animated documentary titled 'Story of Stuff' by Annie Leonard to elicit students' views on materials economy, vested interests of industries in waste generation, and how they ensure that even at the stage of designing and manufacturing various commodities. This film triggered interesting discussions among students, who saw a parallel in the Indian context and pointed out the nexus between the ruling government and two prominent industrialists.

B) Understanding its impact

To analyze the impact of waste on the natural environment, students could be engaged in preliminary testing or secondary analysis of soil, water, and air quality in the region. They can also be encouraged to observe and analyze how plants and animals get affected by waste.

Sanitation and hygiene is a significant determinant of public health. In addition to the importance of maintaining cleanliness and basic hygiene, the discussion on waste and health must include injuries and infections that rag pickers face due to the lack of protective gear, sanitation workers' heavy reliance on alcohol to avoid stench coming from septic tanks, and occasional deaths that can be easily avoided by employing technological support. The discussion on lower life expectancy in areas near dump sites, and among sanitation workers is another important health concern. Contextualized narratives (short vignettes) that I used to trigger discussions on the complex linkages between health, poverty, nutrition, sanitation, and access to healthcare facilities helped elicit participants' ideas of social determinants of health (Fig. 6).

While discussing the impacts of waste on people, it also needs to be pointed out that toxic gases released from piles of garbage could be fatal for people working with waste. In addition, the frequent fires at dumping sites could cause breathing issues to those who live near such sites. Therefore, questions such as what kind of waste is more likely to produce a specific gas, under what conditions these gases are produced, why these gases are harmful to human health, and how to detect the presence of these gases may help the survival of those who are involved in rag picking at landfill sites and those who get down to clean choked sewers and septic tanks. Stories, reports and pamphlets compiled by *Safai Karmchari Aandolan*³ are useful resources to initiate a conversation on this topic.

³ <https://www.safaikarmachariandolan.org/movement>

Shadab's house is right next to the drain that flows near the dumping ground. In rainy seasons, the water starts overflowing the drain. The boundaries get blurred and the house itself becomes part of the drain.

Rukhsar lives in a small society. People there pack their daily waste in polythene bags and throw those bags on the street. Mostly this garbage keeps piling there for days. It starts rotting and smells bad.

Shafiq's house is also close to the dumping. Every morning all the men in his house go to the dumping to defecate. Women go to a private toilet where the water is not so clean.

Fig. 6 Examples of vignettes used to elicit students' views on health, poverty and sanitation

Sociopolitical questions such as the issues of access to clean air, water, and sanitation facilities for those who live near dump sites or earn their livelihoods of city's waste on an everyday basis also need to be raised at some point. A 19-minute long documentary *City's edge*, prepared by the School of Media and Cultural Studies at Tata Institute of Social Sciences, Mumbai, illuminates the hardships of the people in the M(East) ward. To initiate conversations on sanitation workers' living and working conditions with the students, I had used photographs⁴ taken by a Mumbai-based documentary photographer Sudharak Olwe. While we assumed that these photographs would be moving for students, some participant students, to my utter surprise, found those photographs amusing. Perhaps it could have resonated with their own experiences and triggered a sense of embarrassment. Along with other activities, these photographs could also be used to sensitize students on sanitation workers' lives.

Moreover, in my interaction with the officials of SWACH and KVSS members, they had pointed out various issues⁵ that sanitation workers face on an everyday basis. Students would develop an understanding of the complexity and challenges involved in the sanitation work if they interacted with them. Thus, the students can be engaged in a project in which they accompany a rag picker from early morning till the end of the day, interact with them, and document their work similar to the case studies

4 <https://www.sudharakolwe.com/insearch.html>

5 These include issues such as meager wages, no bonus, no identity cards, no protective gear, health risks in the job, temporary nature of contract, no space to sort out collected items, practical challenges involved in waste collection, accountability, user fee, and dignity of job.

developed by organizations like SWACH. As part of the project, they can also analyze various media reports on the Deonar dumping ground and the socioeconomic conditions of people in the M(East) ward. When written accounts of the children of rag-picking communities in Bhopal were used in the workshop context, the participants could easily connect with those and shared their personal experiences with us. Such narratives are powerful in eliciting students' views and educating them about rag pickers' everyday lives.

C) Exploring solutions

To help develop a systemic perspective on waste, curricular experiences that engage students with the socio-material aspects and trajectories of waste practices and waste materials might be helpful (Jørgensen, Madsen & Læssøe, 2018). Levinson (2009) highlights the importance of bringing out *interlocking* narratives that would facilitate students in understanding science in its social context, appreciate the systemic nature of science and connect the local to the global. To demonstrate the possibility of developing such narratives, he takes up the story of aluminium and demonstrates how the extraction and purification of aluminium is linked with the lives of the waste collectors at Rio de Janeiro in Brazil (Levinson, 2014).

Students can also be engaged in concrete activities such as running a composting facility at the community level. As part of the activity, students could discuss various aspects of biodegradability, e.g. microbial pathways that help decomposition, degradation stages, and the relationship of microbial pathways with the growth and propagation of disease vectors. The discussion on recycling could be connected to properties of materials, separation techniques for retrieving materials, and the significance of various grades of plastic. Numerous ideas are available on the Internet for upcycling household waste. Several scientific toys⁶ can be made of trash. While discussing the process of incineration, references can be made to the local incinerator owned by a private company and the problems that it has caused for local people. They could also be encouraged to do investigative journalism or write articles or conduct research on these matters.

Moreover, one of the key aspects of inculcating critical scientific, technological and environmental literacy is to prepare students for sociopolitical actions. One of the exercises that a participant teacher had used in his class was to design a waste management plan for Mumbai city and share the plan with

6 <https://www.arvindguptatoys.com/toys-from-trash.php>

the local government official. The students can take up such open-ended tasks. The case studies of cities that successfully manage their waste have been documented⁷ by institutions like the *Center for Science & Environment*. Students can analyze some of the best practices and use them to make their case. They can also get involved in filing a petition, organizing a rally in the community, distributing pamphlets to make others aware of the issue, preparing and performing a street play on such matters, and putting political pressure on the government. Interactions with people associated with various organizations in the region could also help figure out what actions are possible at the collective level.

With regard to pedagogy, Sharmila Rege, a feminist scholar from India, who draws upon the educational philosophies of Phule and Ambedkar, argues that a transformative critical pedagogy must integrate the Buddhist principles of *prajna* (critical understanding), *karuna* (empathetic love), and *samata* (equity) (Rege, 2010). In the context of the M(East) ward, *prajna* will translate to a critical, systemic understanding of the sociopolitical conditions prevalent in the community, *karuna* would entail enacting this critical understanding through a *culturally relevant* pedagogy (Ladson-Billings, 2014), engaging with students' cultural context, listening to their experiences, and making empathetic connections with them. This would translate to bridging the gap between school science discourse and students' life worlds and creating a 'hybrid' space where educational discourse and out-of-school discourses converse with each other (Barton, Tan, & Rivet, 2008). Enacting the principles of *prajna* and *karuna* will create the necessary conditions for *samata* or equity.

Before I conclude, I recollect a conversation with a sanitation worker affiliated with KVSS who had said that education must be "helpful for our community". Similarly, in a formal conversation, one of the leaders of KVSS, Milind Ranade, insisted that formal education is not true education, rather becoming aware of one's rights and fighting for the same is true education. In that spirit, the challenge ahead for researchers, teachers, and teacher educators is to work with these principles and enable transformative possibilities for communities such as the M(East) ward. The study sheds some light on what is possible and how it can be achieved, but a long battle lies ahead if one is committed to going against the grain.

7 <https://www.cseindia.org/not-in-my-backyard-solid-waste-mgmt-in-indian-cities-6746>

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