TE|SF India
Transforming Education for Sustainable Futures

RESEARCH REPORT | MARCH 2023

DEVELOPMENT OF WATER CLASSROOMS FOR MIDDLE SCHOOL STUDENTS

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Citation

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***** Equal contribution

Year of Publication: 2023 | **DOI:** https://doi.org/10.24943/TESF1206.2023

Dedicated to the memory of Aakriti Parashar whose efforts made this work possible.

Acknowledgements: The support of the Economic and Social Research Council (UK) is gratefully acknowledged by TESF (award title 'UKRI GCRF Transforming Education Systems for Sustainable Development (TES4SD) Network Plus'). We thank the Living Waters Museum (LWM), Centre for Water Research, Science Activity Centre, Department of Humanities and Social Sciences, Department of Earth and Climate Science and the Guest House staff at the Indian Institute of Science Education and Research (IISER Pune) and the Centre for Environment Education (Pune) for content and logistical support. We are grateful to the contributors of the *Punyache Paani* exhibition at LWM who gave permissions to use their content for this project. We thank the students who participated in the workshops, their schools, and parents for their contribution in shaping this project. We appreciate the guidance received from TESF India, TESF Bristol and TESF Mojo teams. We thank Dr. K. Subramanian and Prof. Poonam Batra for their critical comments on the proposal and the report, respectively.

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Acknowledgements

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Image credits

Cover image: Daiwik Pande, Pune
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TABLE OF CONTENTS

ABSTRACT

Water, recognised by United Nations' Sustainable Development Goal 6, is essential to sustain all life. It intersects with various aspects of our civilisation, heritage, health, and survival. In this project, we developed pedagogical tools using place-based, multidisciplinary, imaginal, and interactive content for middle school students. The expected outcome of this pedagogy is to equip students with knowledge and core competencies such as critical transdisciplinary analysis, systems thinking, and collaborative decision-making that are essential to reimagine just, resilient, and equitable water futures. We called this curriculum the "Water Classrooms". The core partners in this work included Living Waters Museum, Centre for Water Research, Science Activity Centre at Indian Institute of Science Education and Research (IISER Pune), and the Centre for Environment Education (Pune). The project was funded by TESF-IIHS and GCRF-UKRI.

This project report details the methodology used to develop "Water Classrooms" through contextual partnerships with multiple stakeholders including experts, educators, grassroot organisations, and students. It examines the data collected during dissemination workshops with around 30 middle school students from six schools in and around Pune using qualitative and semi-quantitative analyses. The report presents ways in which art and writing exercises were used to capture and evaluate the transformation of student perceptions during the course of the sessions. Such analysis helped us articulate the impact of this pedagogy beyond mere outreach statistics. In addition to the physical and biological aspects of water, students were able to correlate its social, cultural, and ethical aspects of water to their everyday lives after the sessions. A student noted "*I never thought water and gender could be related topics.*" The work done over the course of one year (November 2021–October 2022) resulted in four deliverables—an online teaching resource, a policy document, a talk series for holistic understanding of sustainability (and) education, and a physical and digital exhibition-of-learning including students' works of art such as drawings, poems, and stories. All these outputs can be accessed at this **link**. The overall concept, process, and transformations of the participants and educators on the team have been captured in this **short film**.

CHAPTER 1: PROJECT OVERVIEW

Water is essential to life and is recognised by United Nations' Sustainable Development Goal 6. (SDG-6) – clean water and sanitation. Since water intersects with various aspects of our civilisation, heritage, health and survival, the students of today, our "water-keepers" of tomorrow, need to develop an interdisciplinary, integrated, and ethical approach to learning about our waters. Our water education needs to equip students and youth with the aptitude to observe, identify, and understand issues related to water around them, including social exclusion and gendered relations of power underlying access to water. In this project, our goal was to develop pedagogical tools using place-based, visually engaging, and interactive content for middle school students through contextual partnerships that would enable students to reimagine just, resilient, and equitable water futures. We called this water curriculum the "Water Classrooms". The core partners in this work were Living Waters Museum (LWM), Centre for Water Research (CWR), Indian Institute of Science Education and Research (IISER, Pune), Transforming Education for Sustainable Futures (TESF, India), Indian Institute of Human Settlements (IIHS, Bangalore), Centre for Environment Education (CEE, Pune), and Science Activity Centre (SAC, IISER Pune).

To begin with, we wanted to understand the scholarly view on water education and how water is taught through middle school textbooks in India (state and CBSE (Central Board of Secondary Education) boards). The literature review, learnings from interactions with educators, and analysis of existing school textbooks is described in Chapter 2.

LWM's founder, Dr. Sara Ahmed, had a leadership role in the design and development of the interdisciplinary Water Studio as part of the Foundation Programme for all new undergraduates (17–18-year-olds) joining Ahmedabad University since 2019 to explore water from a multi-dimensional lens. Building on this work, Drs. Ahmed and Mathur (in consultation with an advisory group) designed a comprehensive framework that would allow a multidisciplinary understanding of water from local and global perspectives for a younger learner. We collaborated with water experts, academics, grassroots organisations, educators, students (doctoral and post-graduate), and artists to develop a place-based, visually engaging, interactive, student-centred, inquiry-based pedagogy involving a total of 15–20 hours of contact time (Appendix A).

A detailed methodology including the onboarding of students and contributors, developing the course outline and teaching plans, designing, and conducting workshops with middle school students, and feedback collection from observing educators and student interns is presented in Chapter 3. Teaching plans were used with nearly 30 middle school students between July and August 2022 and revised based on the feedback collected from the workshops. We have collated the teaching plans as an online teaching resource (accessible at https://waterclassrooms.in/) which could be used and adapted by those interested in education and capacity building towards sustainable water development. During this one-year long project, the team encountered several challenges including the COVID-19 pandemic, devised solutions towards the completion of committed deliverables. Team members have been able to develop several capacities in the process. These challenges and opportunities are discussed in this chapter.

Some of the learnings, observations, and experiences of students participating in "Water Classrooms" were captured through works of art like drawings, poetry, and storytelling. Several of these worksheets

and artwork were analysed using mixed methods. These contributed to understanding the transformation of students' understanding of water in relation to themselves and larger systems. Details of different workshops, data analyses, and interpretations have been provided in Chapter 4.

The works of art created by students during the workshops has been curated into a physical and virtual exhibition-of-learning. We attempted to make the current discourse on education in sustainable development accessible to school educators through an online, open-to-all discussion series called "Unravelling Sustainability (and) Education". We have drafted a policy document to reflect on how some of the learnings from this project can be useful in education in formal spaces. These outputs are discussed briefly in Chapter 5 and are available through this website: https://waterclassrooms.in/.

CHAPTER 2: BACKGROUND

2.1 Literature Review and Textbook Analysis

Education for Sustainable Development (ESD) is recognised as an integral element of SDG 4 on quality education and a key enabler of all the other SDGs[1]. It aims to enable every learner to acquire the knowledge, skills, attitudes, and values necessary to shape a sustainable future (target 4.7). While countries, including India, use this as an opportunity to disseminate and test strategies for ESD in school education, no single framework has yet been designed to infuse ESD into existing curricula[2]. There are, however, several guidelines that can be used to adapt the existing curricula or design new ones such as Project Y[3] and ESD Lens review tools[4]. Some of the guidelines used in other countries suggest that programmes related to environmental education should be rooted in community issues, involve multiple stakeholders, and incorporate reflection on social institutions and power dynamics (Aguilar, 2018). Others suggest that programmes, especially in water education, produce learning outcomes that include core competencies such as critical and systematic thinking, collaborative decision-making, and taking responsibility for present and future generations,[5] or that they need to be interdisciplinary and holistic with sustainability as a central theme (Brody, 1995). Trans-disciplinary Research Oriented Pedagogy for Improving Climate Studies and Understanding (TropICSU),[6] a global project funded by the International Council of Science, uses climate as a central theme to develop teaching resources that are locally rooted in their context and globally relevant for their science.

Water is a subject that cuts across all disciplines and can be used to bridge traditional disciplines for an integrated and holistic approach to education (Brody, 1995). Research has shown that the understanding of issues and practices related to water, health, and sanitation (WASH) by school students also varies with their cultural beliefs and psychological and personal concerns, as well as their local context (Brody, 1995; Gunckel *et al*., 2012). A study in the United States found that students do not understand and appreciate water flows and are not aware of the connections between water in one location and water in other locations (Gunckel *et al*., 2012). Mathew et al. (2009) report that even in schools that provide WASH-related training in India, students may not follow regular hygiene practices in their daily lives. Amahmid et al. (2019) have noted that the water education in schools will need to become more value-driven, interactive, and activity-based. This could allow behavioural transformation in students that could promote sustainable water futures. They also noted that in the current curriculum in Morocco, water was largely incorporated into the sciences and geography.

In order to examine the status of water education for middle school students in the national and state education boards in India, we reviewed the NCERT (National Council of Educational Research and Training) and Bal Bharti (Maharashtra state board) textbooks for every subject for classes 6–8 and built a

[1] https://open.undp.org/sustainable-development-goals. Accessed on 31-10-2022.

[2] https://iihs.co.in/knowledge-gateway/wp-content/uploads/2021/01/TESF-India-Background-paper.pdf

[3] https://sustainabledevelopment.un.org/content/documents/926unesco9.pdf Accessed on 28-03-2023

[4] https://unesdoc.unesco.org/ark:/48223/pf0000190898

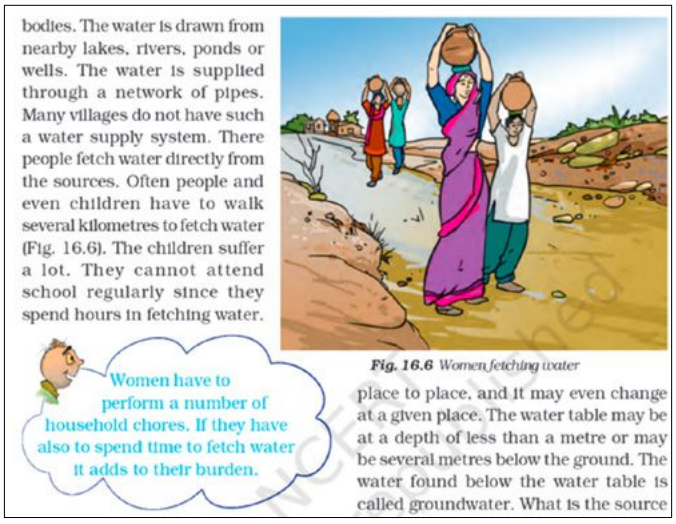
[5] https://en.unesco.org/themes/water-security/hydrology/water-education. Accessed on 31-10-2022.

[6] https://tropicsu.org/

repository of portions in these textbooks that refer to water. The editions of Bal Bharti textbooks used in this study were published in 2019, and NCERT in 2020–21. Textbooks used in the study can be accessed **here**. The complete repository of selected portions of the books can be accessed **here**.

In addition, we also explored sections that refer to social issues. The right to water is considered universal. However, making water accessible to all with equanimity requires a closer look at our social structures and inherent biases. For instance, the gender roles related to water are not "natural" and are instead guided by our social institutions and norms, our cultural practices, as well as the market. A large share of both productive and reproductive work with respect to water use is allocated to women and is often undervalued and underpaid. Similarly, discrimination based on caste has been practised in India for centuries. The notion of impurity and division of labour has had significant discriminatory practices with respect to access to water and sanitation. In spite of the legal resolutions, the practice continues in different ways in our society. We examined the textbooks to understand how these topics are addressed. While the textbooks define such discrimination, little is talked about through the lens of water.

The overall review of the textbooks revealed that there is a greater emphasis on the geographical, physical, and scientific aspects of water compared to water history, heritage, social gender, equity, and water justice. Segregated between science and geography, the study of water can often be decontextualised from the local context and lived experiences of the students. Similar observations have also been reported in studies conducted in other countries (Sammel, 2016). This study noted that the way water is taught in certain Australian and Canadian curricula failed to develop significant social dimensions of the management and movement of freshwater and focussed more on the physical and scientific dimensions in their learning outcomes. Although teaching based on the local context has been seen to improve learning even in the field of science, education in several countries remains largely decontextualised from local situations and lived experiences (Bennett et al., 2007).


bodies. The water is drawn from nearby lakes, rivers, ponds or wells. The water is supplied through a network of pipes. Many villages do not have such a water supply system. There people fetch water directly from the sources. Often people and even children have to walk several kilometres to fetch water (Fig. 16.6). The children suffer a lot. They cannot attend school regularly since they spend hours in fetching water.

Women have to perform a number of household chores. If they have also to spend time to fetch water it adds to their burden.

Fig. 16.6 Women fetching water

place to place, and it may even change at a given place. The water table may be at a depth of less than a metre or may be several metres below the ground. The water found below the water table is called groundwater. What is the source

Figure 2.1. A view of the NCERT textbook from Class 7 with the only reference to the issue of gender and water | Source: NCERT, 2020–21

While short case studies from different regions of India may be present, the curricula do not provide an opportunity to students to observe and problematise local questions and issues around water such as pathway for water that reaches their homes, how wastewater created in households affects water bodies around them, or inequity in access to water. Some existing water curricula[7,8,9,10] provide activities to enable such local explorations. However, many of these are still rooted in science and geography and do not support an in-depth exploration of the socio-economic institutions, challenges, and opportunities related to water management by either the facilitator or the student. They also do not provide the support on how to build interdisciplinary knowledge and systems thinking in environmental education.

We explored whether such capacities could be developed through a more interactive and visually engaging pedagogy. Empirical studies examining student perceptions of water (Covitt et al., 2009) and the existing water curricula for middle and high school students often use visually engaging and interactive content. In the Dominican Republic, the facilitators for community health clubs use picture-based curricula to educate people about water, health, and sanitation (Nordhauser & Rosenfeld, 2020). Several museums around the world like those part of the Global Network of Water Museums visually communicate our relationship with water and its tangible and intangible heritage. Living Waters Museum, a digital repository of our tangible and intangible water heritage and a key partner in this project, has engaged youth all over India to develop interdisciplinary water narratives. They engage youth to develop content that makes topics such as water values (A) and socio-political factors affecting access to water (B) more accessible through storytelling and visualisations (Figure 2.2).

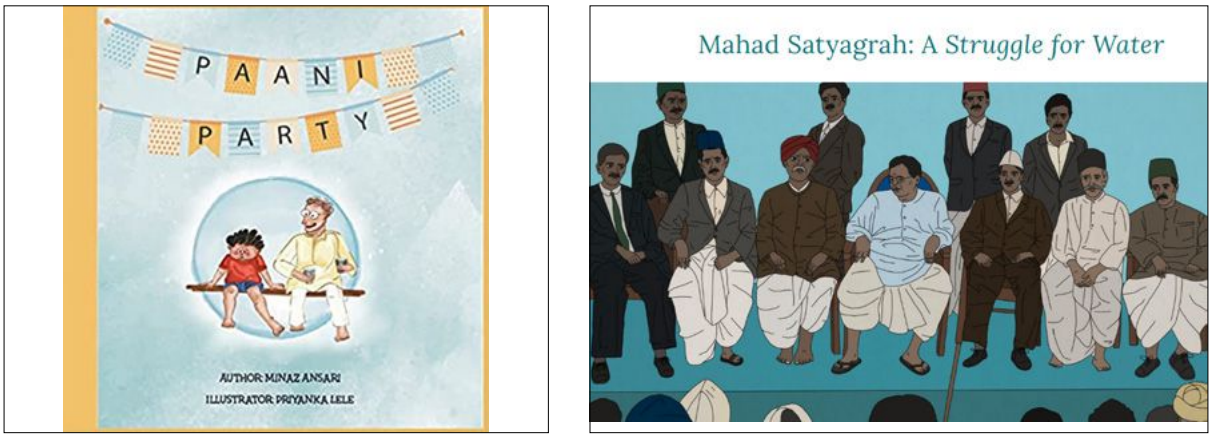


Figure 2.2. Examples of storytelling and visualisations at the Living Waters Museum. (A) The storybook Paani Party by Minaz Ansari allows students to explore the value of water in life. (B) The illustrated story about the Mahad Satyagrah by Siddhesh Gautam, a civil resistance led by Dr. B. R. Ambedkar where Dalits asserted their moral and legal right to access water from a public tank Source: (A) Ansari and Lele, 2021; (B) Gautam, 2021

[7] https://thehearthadvisors.com/our-work/pani-pahar-the-water-curriculum

[8] https://www.swarovskiwaterschool.com/teaching-materials

[9] https://tropicsu.org/

[10] https://www.watereducation.org/

2.2 Educator Opinion

We sent educators a Google form-based survey about the Water Classrooms project and asked if they were willing to participate and address a few questions regarding water education in middle schools in Pune, India. The aim was to collect information from practitioners on how they viewed water education in middle school and what changes they thought were required. The form was filled by participating educators whose narratives are in Appendix B.

We found that the responses from the educators were similar to our observations of school textbooks and curricula. Educator narratives highlighted that middle school education focusses on water as a resource and largely talks about its physical and geographical aspects. These are mostly taught through theoretical sessions and very little experimentation. However, the curriculum does not enable focussed conversations on social, cultural, and equity related aspects of water use, access, or management. Interestingly, in one case, the transition to online teaching during COVID-19 which restricted the possibility of experimentation led the educator to explore these aspects of water through movies.

In general, middle school teachers neither have a framework nor are formally trained to discuss sustainability as a subject. The focus remains on water quality, treatment, and conservation. However, most educators we interacted with believed that education related to water and sustainability would best be imparted through activities, conversations, role playing, and other such interactive methods.

2.3 Exhibition on Pune's Waters

This project coincided with another project that the principal investigator (PI) was engaged with during this time—curation of visual narratives on Pune's waters for the online exhibition *Punyache Paani* which was launched on 28 March 2022, by LWM and CWR at IISER Pune, along with several partners from civil society and academia. The exhibition is hosted online at https://punyachepaani.livingwatersmuseum.org/. This work collates the water history, heritage, and challenges in Pune over time and Pune's development from a hamlet to a city. We received permissions to use many of the visuals and subject matter from the exhibition (stated below) as a teaching resource in the TESF India project:

a. A timeline of Pune's water history, based on archival research, tracing the evolution of early systems for storing water to the aqueducts built by the Peshwas in the 18th century, to the colonial and post-colonial dams, pipelines, sanitary systems, and hygiene measures.
b. Narratives on traditional access to water, hydro-philanthropy, and water ethics collated by experts at PVP College of Architecture and IISER Pune.
c. A children's book on the riparian environment along the Ramnadi River in Pune was developed by the Visual Stories Studio in consultation with Jeevitnadi - Living River Foundation.
d. Content developed to understand Pune's contemporary relationship with water, floods, and ground-water by experts at IISER Pune.
e. Digitised infographic of Pune's rivers (Mula and Mutha) and related history, heritage, and culture, developed by Studio Vitamin-D.
f. Tracing the flow and ecological features of Ramnadi from its origin to its confluence with the Mula river in Pune and Pashan lake.
g. Livelihoods associated with Pune's rivers.

CHAPTER 3: METHODOLOGY

3.1 Contributors and Roles

Living Waters Museum's founder, Dr. Sara Ahmed was involved in developing the Water Studio as part of the Foundation Programme at Ahmedabad University which was made mandatory in 2019 for all incoming undergraduate students. When the project PI (Chhavi Mathur) started working with LWM in 2021, they decided to extend this and bring the Water Classrooms to middle school students. We started talking to partners and developing an overall structure for the curriculum. Much of this work required funding which came through TESF India.

Having worked with basic sciences which generally have a universal focus for a long time, the PI was keen to explore how learning about one's local environment can help gain a global perspective. With this as one of the goals, she worked towards developing *Punyache Paani*, an exhibition on Pune's waters where more than 30 professionals and young researchers came together to develop water narratives of Pune's water heritage, history, people, and ecology. This served as a platform for building content and partnerships which fed into the Water Classrooms project with TESF India.

The interdisciplinary nature of Water Classrooms meant that experts and practitioners from several fields had to be engaged. We reached out through our networks in LWM and IISER Pune and onboarded several individuals for content writing—water researchers, educators, ecologists, biologists, data scientists, climate scientists, disaster management experts, artists, musicians, filmmakers, experts working on issues of gender, equity, water justice and governance, and student interns to develop activities. While the content from *Punyache Paani* was developed in consultation with hydrologists, we did not have active consultation with an economist for any of the content developed during this project. The names and affiliations or expertise of all contributors are listed in Appendix A.

At the beginning of the project, we had formed an advisory team who supported the initial brainstorming, advised on essential topics to include, and helped reach out to schools and educators who could be involved in the project. We continued our engagement with some of them (whom we call core advisors) during content development and workshops. Through these advisors we were able to connect with educators from five different schools in and around Pune. With a strong focus on co-creation expected in TESF, we engaged six educators (core group of educators) in student recruitment, advising during content generation, review of written content, workshop facilitation, workshop observation, and post-workshop reviews. Additional educators listed in Appendix A engaged in one of these tasks during the project. Along with a few schoolteachers and the project PI, some of the advisors and experts also facilitated workshops on various topics.

Six IISER Pune BS-MS students also joined the project to support various tasks such as research, content writing, workshop organisation, data collection and digitisation, workshop photography and videography, social media and design, managing talk series, and a student exhibition.

Several people managed multiple roles during the project; their names and affiliations or expertise are listed in Appendix A. Appendix C lists the challenges faced by, and capacities developed for different groups.

Along with TESF India-IIHS, the important institutional partners in the project have been the following:

- Living Waters Museum, Centre for Water Research, IISER Pune
- Centre for Environmental Education, Pune
- Science Activity Centre, IISER Pune
- Department of Earth and Climate Science, IISER Pune
- IISER Pune

3.2 Course Outline

We referred to some of the work done through the Water Studio at Ahmedabad University, other water curricula, and the analyses of NCERT and Maharashtra board school textbooks undertaken by our team. Based on these, we formulated a course outline which would enable exploration of water through a multi-dimensional lens. The outline began with our personal relationship to water, to shared waters and social equity to water systems, and the challenges to sustainability at a planetary scale such as pollution and climate change. These modules were further divided into specific topics which evolved over time. The current list is as follows:

Module 1- Water and Self
WC-1-1 Water and 'my'self
WC-1-2 Where does my water come from?
WC-1-3 Water I use daily
WC-1-4 Virtual water
WC-1-5 Water and disease

Module 2 – Shared waters
WC-2-1 Water values and cultural practices
WC-2-2 Water as a human right and rights to water (access, caste, gender, poverty)
WC-2-3 Water and gender
WC-2-4 Water and the arts

Module 3 - Our water systems
WC-3-1 Who manages our water?
WC-3-2 Water and agriculture (Part-I)
WC-3-3 Water and agriculture (Part-II)
WC-3-4 Wastewater
WC-3-5 Water and energy
WC-3-6 Water and disasters

Module 4 – Water and the planet
WC-4-1 Water and climate

WC-4-2 Oceans and us
WC-4-3 Water and biodiversity
WC-4-4 Water and what I can do

The content writers, in consultation with the project PI, developed a teaching plan of 30 + 30 minutes for each of these topics. They used a template adapted from teaching plans provided by the Pani-Pahar curriculum. The template is included in Appendix D. The teaching plans were reviewed by the educators and the revised versions were shared with workshop facilitators. Of the 19 planned topics, we have written 18 and tested 17 teaching plans. Some of these were conducted in a more experimental manner.

One of the topics for which the teaching plan has not been fully written—WC-4-4 (Water and what I can do) —was partially incorporated in other teaching plans and activities. "What students can do" has been discussed as a part of several sessions like the one in the Shared Waters module, discussions on wastewater as well as a special session conducted before the Ganesh festival by the Centre for Environment Education.

3.3 Student Onboarding and Ethics

Teachers from four different schools in and around Pune selected 31 students to participate in the Water Classrooms. There were 4 students onboarded from the Balshikshan Mandir English Medium School (Pune; BSMEMS), 6 students from Jnana Prabodhini Navnagar Vidyalay (Nigdi), 9 from SNBP International School (Pune), 9 students from Vikhe Patil Memorial School (Pune' VPMS), and 2 students from Sevasadan English Medium School. One student from DriveChange and Learning Resource Centre (DLRC) joined for selected sessions.

BSMEMS and Jnana Prabodhini use Bal Bharti books (Maharashtra state board), and VPMS, SNBP International, Sevasadan, and DLRC schools follow NCERT books (Central Board of Secondary Education (CBSE)). Students were largely from class VII and VIII. Due to COVID-19 vaccination requirements on the IISER campus, class VI students were not allowed to enter and thus could not participate. There were 13 male and 17 female student participants. The group[11] consisted of students identifying with four different religions and five different castes, sub castes, and tribes. Students came from joint, nuclear, or single parent families.

We went through the official ethics procedures at both IIHS and IISER Pune and received clearance from both institutes before conducting workshops. As per the guidelines, we informed all workshop participants and/or their parents/guardians and teachers about the goals and nature of the project and its outputs, the tasks and time commitment expected from the participants, the voluntary nature of their engagement, privacy and data handling procedure. This was done through an online meeting session[12] and consent forms which were designed in consultation with IIHS and IISER ethics committees. Signed consent forms were collected from all participating teachers and students' parents/guardians.

[11] There was 60 per cent voluntary disclosure of diversity information.

[12] Orientation and ethics presentation can be accessed at - https://docs.google.com/presentation/d/11cnWbLp-RtQO5zpMeAZSnboCIV6Fs9iL/edit?usp=share_link&ouid=103758404236991242035&rtpof=true&sd=true

3.4 Workshops, Data Collection and Handling

The workshops were conducted at IISER Pune over seven Sundays in July and August 2022. The dates of the workshops were decided in consultation with teachers considering their school schedules and those of our student interns and project partners. The venues were equipped with blackboards and slide projectors (Figure 3.1A). The seating for most workshops was cafe style with several round tables to allow group conversations. One workshop was conducted in regular classroom seating and another one in laboratories. Most workshops discussed two topics, each for about an hour to an hour and fifteen minutes. The workshops started at 10:15 a.m. and went on for three hours with a snack break in the middle (Figure 3.1B). Participating students, teachers, Water Classrooms team members, and one or two other observers attended the workshops. All activities pertaining to this project were systematically documented with photographs, audios, videos, and notes.

Figure 3.1. (A) The venue for the majority of the sessions; and (B) snack break on one of the days

Source: TESF-LWM Water Classrooms project team, 2022

During the snack break and at the end of the session, our team collected audio feedback from the students. After each session, the team and observers would have lunch together followed by a feedback session. Two separate feedback forms were designed, one for the facilitator who had closely interacted with the teaching plan, and the other for the observers (we referred to them as moderators as well). Feedback forms can be accessed **here**. Everyone would spend 15–20 minutes reflecting on their experience and submitting them in the forms. This was followed by an open discussion about the session which would last 30–40 minutes.

Each topic was taught by one lead facilitator who was sometimes assisted by a co-facilitator. The facilitator prepared the plan and slides for the session based on the teaching plan. The project PI worked extensively with the facilitators to understand requirements and challenges for the facilitator to plan the session as envisioned through the teaching plan. The edits required for the teaching plan were either made before the session or submitted through the feedback forms. The worksheets were planned in consultation with content writers and edited during the interaction with the facilitator if required. Each worksheet had separable name tags which were used to number code the worksheets. They were then removed before analysis to anonymise the collected data and prevent bias during analysis.

Most of the work to plan and prepare the worksheets was carried out by the project PI and the team keeping in mind the goals of the project. Written answers or drawings by students as part of the class exercises were then used for qualitative and/or semi-quantitative analyses. Some of these are reported and discussed in Chapter 4.

CHAPTER 4: FINDINGS AND DISCUSSIONS

4.1 (Dis)Connect with Nature

4.1.1 Where does my water come from?

(Refer to Teaching Plan WC-1-2- Where does my water come from?)

Both Bal Bharti and NCERT class 6 and 7 textbooks state that water reaches taps from various sources such as rivers, ponds, lakes, glaciers, and even oceans (through the desalination process). In a couple of sentences, the book explains that water from rains and snow is captured in the mountains and flows down as streams and rivers. The pictorial depiction of this shown in Figure 4.1 does not show rainfall but can be interpreted to be depicting a downward movement of water through the mountains.

Figure 4.1. Depiction of rainwater flowing down in the form of streams and rivers as given in NCERT Class 6 textbook, Chapter 14: Water | Source: NCERT, 2020–21

Right at the beginning of our session Water Classrooms 1-2 (Where does my water come from?), we asked students to draw where their water comes from and trace the waters back to rainwater.

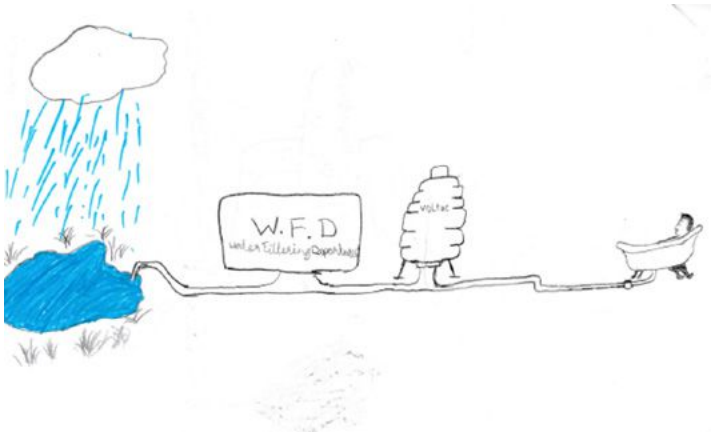


Figure 4.2. Illustration by a participant for “Where does my water come from?” in the beginning of the session (pre-instruction) Source: TESF-LWM Water Classrooms student participant, 2022.

Many of the responses were similar to the one shown in Figure 4.2, where the rainwater is collected in some ambiguous collection body or reservoir on land and then piped into an overhead tank from where it reaches the taps at home. There were some variations such as the collection body or reservoir being

sometimes defined as a river or rainwater harvesting system. Some illustrations depicted centralised or local water purification systems. One of the interns reported that some students found the exercise challenging. From these illustrations, it was apparent that students did not have a clear understanding of how rainwater makes its way through nature and into our homes.

This exercise was followed by an approximately 45-minute session where the educator talks about various sources of water on earth and their distribution. A more focussed discussion about the path of rainwater captured as surface water in the Sahyadri hills to the west of Pune followed. Rainwater falling on the ground flows as streams and rivers or enters the ground and flows through the aquifers. The flow of rivers, aquifers, and springs is sometimes interrupted by dams, dug wells, borewells, or the cutting of the hills. Eventually the water is either collected at these natural sources or reaches homes through piped water systems or water tankers. The resources used to facilitate a more discussion-based session included several images and videos sourced from the LWM exhibition—*Punyache Paani*—and other works created by grassroots organisations specifically working with Pune's waters.

Figure 4.3. Illustration of 'Where does my water come from?' after the in-class discussion on how Pune receives its waters

Source: TESF-LWM Water Classrooms student participant, 2022

When students were asked to redraw "Where does my water come from?" more students included natural and topographical features in their illustrations (Figure 4.3). An analysis of natural and human-made tokens and concepts mentioned in all illustrations before and after the session show that students included more natural elements after the session (Figure 4.4), especially streams, tributaries, aquifers, mountains, springs, and groundwater.

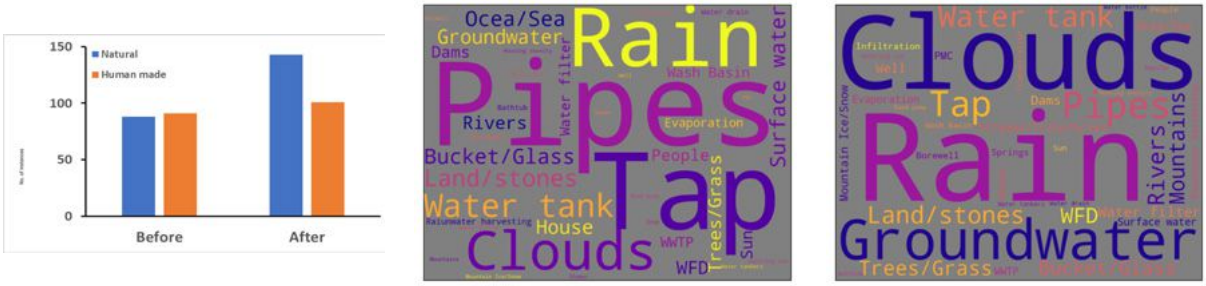


Figure 4.4. (A) Quantitative and (B) qualitative comparison of vocabulary or concepts related to the natural world or (C) human-made items before and after the session | Source: TESF-LWM Water Classrooms project team, 2022

4.1.2 Visualising groundwater

(Refer to Teaching Plan WC-1-2- Where does my water come from?)

The textbooks briefly describe groundwater, groundwater recharge, water table, use of groundwater in construction, industries and agriculture, and depletion of groundwater due to human activity. The illustration (Figure 4.5) largely supports the description, except that it fails to label aquifers and groundwater in the upper layer of water. The illustration does address how groundwater can be accessed in natural and man-made ways.

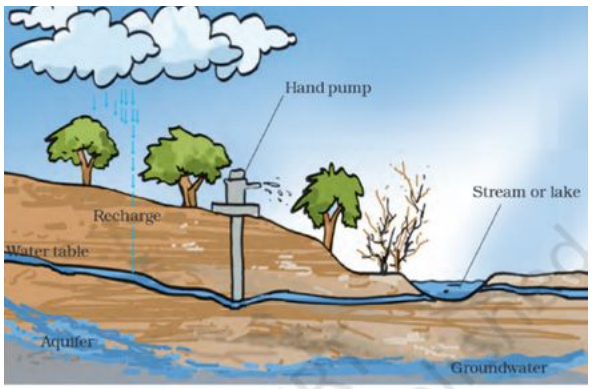


Fig. 16.7 Groundwater and water table

Figure 4.5. Depiction of groundwater and water table in NCERT Class 7 textbook, Chapter 16: Water | Source: NCERT, 2020–21

Before the session we asked students to draw what groundwater looks like (Figure 4.6). Some depicted groundwater as disconnected pools of water underground (A), some as a continuous layer of water underground disconnected with the surface (B), or as equivalent to surface water such as rivers and the seas (C). Many of those who drew access to groundwater showed it as human-made structures such as wells and handpumps (D). Most of these images are based on textbooks. They appear to represent the issue of rote learning and do not demonstrate development of observation skills, critical thinking, and systems thinking perspectives (which are critical in ESD) in middle school students.

Figure 4.6. Student drawings that depict their perception of what groundwater looks like | Source: TESF LWM Water Classrooms student participants, 2022

The lack of clarity in understanding and visualising groundwater was also evident in the discussions. For instance, nearly 40 per cent of the class did not think that groundwater contributed to the water cycle. Those who did believe that groundwater contributed to the water cycle suggested that it could be made accessible only with wells and tube wells. Even though the students seemed to understand the geological relationship of groundwater, textbooks do not explicitly describe “springs” and the role of groundwater in the water cycle remains incomplete.

We asked the students to analyse and write 2–3 observations about an image of the cross-section of a hill that shows the aquifers within it (Figure 4.7). Only 2 of 23 students talked about the relationship between construction and groundwater. None of the students could identify the aquifers in this image representing a real scenario.

Figure 4.7. Aquifers in hills of Pune exposed during construction activity | Source: Sarode (*via* Divekar, Punyache Paani), 2022

We designed/adapted the session to address some of the issues apparent from their drawings and interpretations. We used a video developed by the Living Waters Museum (LWM) and Science Media Centre from the exhibition—"*Punyache Paani* – Stories of Pune's waters"—to demonstrate these issues. We also used another video which talked about springs that feed into a river that flows through Pune and is endangered by the urban development happening around it.

The above-mentioned observations and discussions demonstrate that it is important to use visual stories from the local context to teach environmental studies:

1. Illustrations and images helped us understand how students interpret concepts from textbooks and identify their misconceptions. Such analyses can inform pedagogy to make it more student-centred, thus making students equal or active stakeholders in their education.
2. Students do not always intuitively relate information and concepts from textbooks to the world around them. It becomes crucial to bring examples from the local context into the pedagogy to help them identify problems and devise solutions.
   For instance, Pune lies close to the catchment areas in the Sahayadri hills, has five rivers flowing through it, and has one of the most complex aquifer systems in the country. Pune's development is closely intertwined with its waters, and ongoing urbanisation has led to several water challenges. This makes Pune a very interesting place to understand water from a holistic perspective.
3. The points above reinforce the need to develop more resources, especially visual resources, that are grounded in the local context and share them widely so they can be used as educational resources. This also brings to light the need for our education system to enable teacher education programmes, flexibility in curriculum and infrastructure to use such resources in their classrooms.

4.2 (Just?) A Glass of Water

A glass of water—can it start a conversation? In textbooks, offering a glass of water is spoken of as a means to welcome a guest. What more can we talk about through a glass of water? Or is it too simple an "object" to discuss? Can it lead to knowledge generation? Can it lead to arguments? Can it lead to action?

4.2.1 A glass of (cold) water

(Refer to Teaching Plan WC-1-1-Water and 'My'self)

After welcoming the students to their very first session at the Water Classrooms and collating their understanding of water, the first image that we put up for discussion was the image of a glass of water (Figure 4.8). When asked what they thought was inside the glass of water, we got several responses such as "water in a glass", "water with bubbles in a glass", and "cold water in a glass": We asked the students to assume cold water in the glass and tell us where they thought the water droplets on the outside of the glass came from.

Less than 50 per cent of the students correctly said that the droplets came from the water in the air (water vapour). Some others knew that this was due to the condensation process but could not identify the source of the water droplets. This gap in understanding has also been previously reported by Gunckel et al. (2012).

Figure 4.8. A glass of water | Source: (A) Wikimedia commons; (B) TESF-LWM Water Classrooms project team, 2022

Considering a large proportion of students are unable to identify the source of water outside the glass, it indicates that this rather simple activity (also given in school textbooks) could help in acquiring a better functional understanding of water vapour and condensation and thus, the water cycle.

4.2.2 Responding to a glass of water

(Refer to Teaching Plan WC-2-1-Water Values and Cultural Practices)

In a subsequent session, we presented students with a glass of water (Figure 4.8) and asked them what they think of first when they see a glass filled with water. Of the 26 students, 20 said they think of drinking (or even gulping down) the water in the given glass. Some students said they would reuse leftover water by watering plants. Others talked about the physical properties of water (purity and water temperature) or approached water from a celebratory perspective – play/beauty/magic, while one student specifically said that they thought there was nothing magical about water. Of the 3 students who thought about water as a molecule, 2 also marvelled at the fact that water supports all kinds of life. One student talked about sharing water with someone who needs it more than them.

An educator can choose which thread they want to carry forward from the variety of thoughts that are put

forth by the students. We decided to take the discussion forward around shared waters—water values, right to water, access, and gender.

4.2.3 Water values

(Refer to Teaching Plan WC-2-1-Water Values and Cultural Practices)

Students were divided into groups and asked to analyse 12 images (sourced from the exhibition "I Remember Water" by WAMUNET) and match them to the five water values—environmental, social, economic, spiritual, and governance (Figure 4.9A). Following this, the students were asked to prioritise water values. The results are shown in Figure 4.9B.

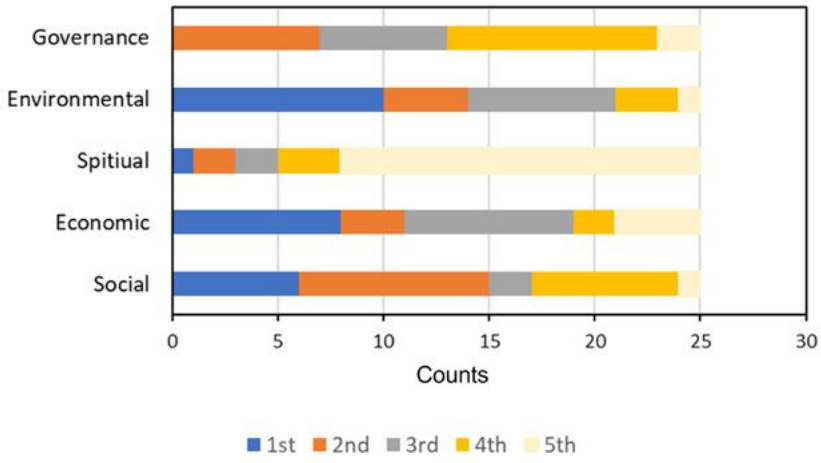


Figure 4.9. (A) Students matching visual stories to water values; and (B) Stacked bar chart showing the cumulative frequency at each priority level (1–5) for different water values | Source: TESF-LWM Water Classrooms project team, 2022

According to the median values, the priority scheme for water values in this group of students was environmental=social > economic > governance > spiritual. A discussion about these choices led to spontaneous debates amongst students about how, when, and why certain values of water should/ can be prioritised over others. When asked which values are in conflict with each other, a collective discussion highlighted that the economic value of water—the commodification of water —conflicted with other values like social, environmental, and social. This exercise allowed cross-disciplinary analysis of

human interactions with water which were otherwise not possible due to the disciplinary segregation in the existing school curricula. We observed that students drew on their lived experiences to explore the values of water. This enabled expression and exploration of diverse thoughts and ideas in a safe space in the classroom.

4.2.4 Water and access (right, caste, poverty)

(Refer to Teaching Plans WC-2-2-Water and Access (rights, caste, poverty) and WC-2-3-Water and Gender) We discussed (Figure 4.10) what the human right to water implies and also challenges of access to water and sanitation as a result of gender and caste-based discrimination. We also looked at how public access to water, or water for all through hydro-philanthropic efforts in the past have changed over time with the commodification of water, and how organisations such as the Pani Haq Samiti in Mumbai are responding.

Figure 4.10. (A) Discussions about water and access; (B) Visual story on Mahad Satyagrah from the Living Waters Museum exhibition, Confluence; and (C) Visual story of caste-based discrimination by a student from Shaheed school, Raipur (collaboration with another TESF grant awardee—Shreya Khemani—Project PI for the project titled 'Interrogating what reproduces a teacher') Source: (A) TESF-LWM Water Classrooms project team, 202.; (B) Gautam, 2021; (C) Pathak, 2022

We also designed an activity called the Water Privilege game based on a similar activity described by Biswas and Thomas (2017). For this activity, six characters with different socio-economic backgrounds and access to water were developed. Each group of students was assigned one character and asked 10 simple questions about their water access and availability—e.g., do you have enough water to bathe every day? All groups start together at the same line and characters with more privilege moved further ahead compared to those less privileged (Figure 4.11).

Figure 4.11. Water privilege game – some groups (more privileged characters) have moved further than the others (less privileged characters) | Source: TESF-LWM Water Classrooms project team, 2022

This activity was followed by discussion and writing exercises where students could reflect on the reasons why some characters could move forward, and others could not. As can be seen from Figure 4.12, economic capacity was considered important by most students, indicating a higher awareness and willingness to talk about the economic factors in middle school students. However, the exercise also facilitated the identification of caste, habitat—urban/rural or organised/unorganised housing, household responsibilities, and other factors influencing access to water that affect one's progress in the game and consequently in life. A few illustrative quotes from students are given in Box 4.1. Students added that along with the access to water, these social and economic factors affected one's ability to obtain safe water, their access to sanitation facilities, and education which could in turn affect the health and well-being of people. We observed that such activities can bring social issues like caste and privilege—which some teachers find hard to discuss in their classrooms—out of textbooks and into real life.

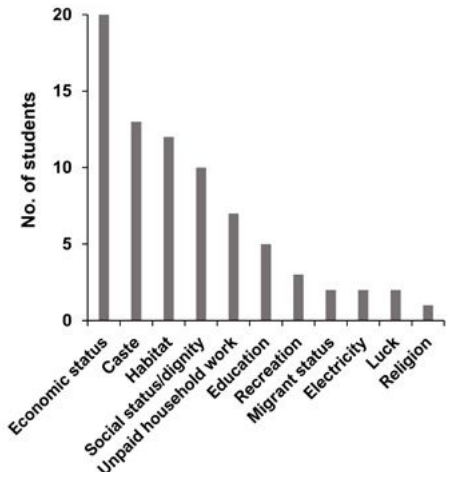


Figure 4.12. Bar chart of number of students listing different reasons for characters to move ahead or fall behind during the water privilege game | Source: TESF-LWM Water Classrooms project team, 2022

"Rich people use money and takes more water – and therefore lower class families can't get water…"

"…Lower caste status (not respected, had to wait because of certain reasons related to caste). Getting exhausted while getting water…"

"… The factors that disallowed some children to move ahead were their unequal right to water…."

Box 4.1. Quotes from students' where they articulate direct connections between access to water and poverty, rights, and caste

Source: TESF-LWM Water Classrooms student participants, 2022

When asked what students could do to facilitate more equitable access to water, most students said they would use less water and spread awareness about the need for conservation of water. The action items (Figure 4.13 and Box 4.2) could be divided into three categories -

1. actions towards self—carrying their own water bottles, reusing water for watering plants, 'cutting *paani*' in restaurants, bathing with less water, closing taps.
2. sharing—direct sharing of their own waters, philanthropic efforts.
3. systemic changes—creating water storage or reusing structures (for rainwater and waste(d) water), decommodification of water, developing utilities to allow better access.

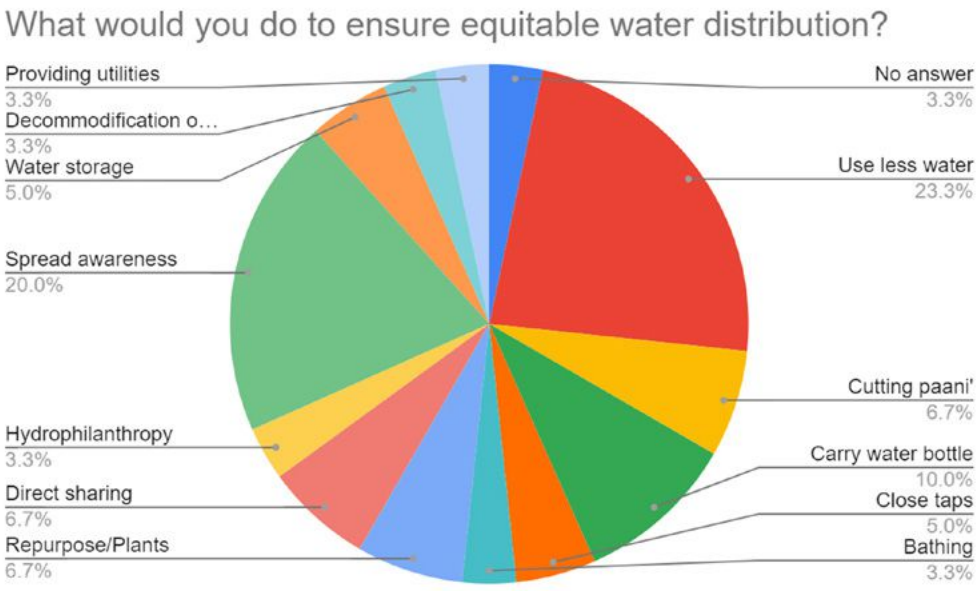


Figure 4.13. Distribution of responses to actions that students listed to allow equitable access to water

Source: TESF-LWM Water Classrooms project team, 2022

"...donate money to set up drinking water fountains around disadvantaged areas like slums…"

"I will save water and also make a [resolution] to fill 2 drums everyday till 365 days. Then will tell people to workout with this method and at a point we will have enough water to come out of water shortage."

Box 4.2. Quotes from students reflecting their intent towards philanthropic actions to ensure equitable access to water

Source: TESF-LWM Water Classrooms student participants, 2022

Prior to the session, we had consulted with educators for their opinions on how sensitive students were to issues related to discrimination. Educators were not sure how such issues could be dealt with in class or how students might respond to it, making it an uncomfortable topic to broach. When we conducted the water privilege activity, we received discernible emotional responses from the students—the ones moving ahead fast were generally cheerful while the ones who could not move ahead demonstrated frustration and bafflement. In the discussions after the activity, the students showed no hesitancy in discussing issues related to social discrimination and biases. A student pointed out—"*...So despite independence and [the] caste system [being] strictly abolished, it still exists in [a] different way."* One teacher's feedback said that the visuals, activities, and discussions allowed a safe space for conversations about privilege to happen, which according to this and other teachers can be a sensitive topic in a classroom setting.

These sessions helped us explore the experiential and interactive aspect of the proposed project. We used techniques such as storytelling and role play to equip students with the aptitude to observe, identify, and understand issues related to water around them, including social exclusion and the gendered relations of power underlying access to water. While the discussions about prioritising water values and gender roles stir up dialogue within the classroom, we observed that awareness and opinions about issues may not lead directly to the ability to engage in stakeholder negotiations and conflict management.

4.3 Water - A Precious Resource

4.3.1 Water I use

(Refer to Teaching Plan - WC-1-3-Water I use and Virtual Water)

Figure 4.14. Group activity matching a product to the amount of water that goes into its production (a.k.a. virtual water)

Source: TESF-LWM Water Classrooms project team, 2022

When we asked students how much water they thought they used in a day, their answers varied from 10 to 88 litres. We designed an activity adapted to the Indian context from the Heinemann Go Science series (Book 3) where the students themselves calculated and estimated the amount of water they used in a day. The result was nearly one order of magnitude higher than what students had estimated at the beginning of the session. We talked to them about virtual water (indirect water usage through the food one eats or products or facilities one uses) and their overall water footprints through a 'match-the-card' activity (Figure 4.14). As seen in the image, it was a popular belief that production of a mobile phone required no water. This was when it struck students how much water they used. Many showed surprise and disbelief. Some students were reluctant to write down the numbers worried their calculations were wrong since water usage calculated was much higher than they had anticipated. For instance, some students who predicted that they consumed about 30–40 litres realised that their actual consumption was about 250 litres. Few others who predicted that they consumed 10–15 litres of water per day realised after calculating that they use nearly 500 litres of water per day. While most students predicted that they used less than 100 litres water every day, the calculated water usage ranged from 105 to 1036 litres with the median at 348.5 litres. Therefore, many of the students found that they used more than the recommended litre per capita per day (lpcd) value of 135 litres for the urban water supply in India.

4.3.2 Managing our natural resources

(Refer to Teaching Plan WC-3-1-Who manages our waters?)

"Tragedy of the commons" refers to a situation in which individuals with access to a public resource where no user rights are defined (also called the "commons") act in their own interest and, in doing so, deplete the resource over time (Garrett, 1968). Water is a natural flow resource and like all other natural resources can be subject to the tragedy of the commons. From several perspectives—economic, ecological, and sustainability—it is important that students understand the reasons behind the tragedy of the commons so they can make more sustainable and environmentally friendly choices.[13]

[13] https://online.hbs.edu/blog/post/tragedy-of-the-commons-impact-on-sustainability-issues

We planned an activity (Figure 4.15) based on one of the commons examples—overfishing—to facilitate experiential learning for students about this theory as well as the intricacies of natural resource management and governance.

Figure 4.15. Group activity to understand the tragedy of the commons using overfishing as an example

Source: TESF-LWM Water Classrooms project team, 2022

The groups had extensive discussions on how to manage the water body and fish population available to them based on their understanding of the roles and responsibilities of different stakeholders. Students realised that certain characters may overfish and that affects the number of fishes in the common pool as well as other components of biodiversity interacting with the fishes (in this case, the birds that feed on the fish) and other stakeholders. Groups found ways to negotiate and manage resources as soon as the fish began to deplete in the pool. In one of the groups, all stakeholders participated (Figure 4.15) in decision-making, while in others one stakeholder decided for the entire group and others agreed. The third group reached an impasse and negotiations went on too long, preventing the game from proceeding. These experiences were shared with everyone in the session after the activity, demonstrating the intricacies of managing a natural resource. We also talked about various kinds of water management systems—traditional/modern, formal/informal, centralised/decentralised—through examples and visuals, many of which were collated during the *Punyache Paani* exhibition or other work done at LWM (Figure 4.16).

Figure 4.16. (A) Stepped ponds (*baravs*) in and around Pune as an example of traditional, centralised water management system; (B) Bhishtis (water carriers) as an example of decentralised, informal water management system Source: (A) Marathe, 2022; (B) Tandon, 2017

Figure 4.17. After the session on 'tragedy of the commons' with post-graduate students at IIT Bombay

Source: TESF-LWM Water Classrooms project team, 2022

The PI was invited to the Indian Institute of Technology (IIT), Bombay to conduct the activity related to the "tragedy of the commons" for first year post-graduate students of Ecology and Environment (Figure 4.17) and present her work with the Living Waters Museum and TESF India. This activity incited similar, albeit more complex discussions with this group suggesting that this activity can be planned in a way that it can cater to students at different stages in their education.

These sessions allowed us to use water to talk about several intersecting disciplines such as resource management, economics, governance, and ecological relationships.

4.3.3 Water and energy

(Refer to Teaching Plan - WC-3-2-Water and Energy)

Water and energy was one of the most multidisciplinary sessions we conducted. We started the discussions with the physics behind hydroelectric power plants using simple hands-on models developed by the Science Activity Centre at IISER Pune. This was followed by the technological possibilities and alternatives to big dams. We then showed students a movie called *Voices of Teesta*, made by an award-winning filmmaker, Minket Lepcha, about the hydroelectric power plants along the river Teesta. Teesta is a tributary of the Brahmaputra in the north-east of India and a transboundary river between India and Bangladesh. The movie shows the impacts of large hydroelectric power plants on riparian biodiversity, livelihoods, and social and cultural practices of people living with the river. The movie also talks about governance and people's participation. Using the movie and news clips during the monsoons, we also introduced the concept of upstream and downstream in the context of rivers, dams, and transboundary conflicts.

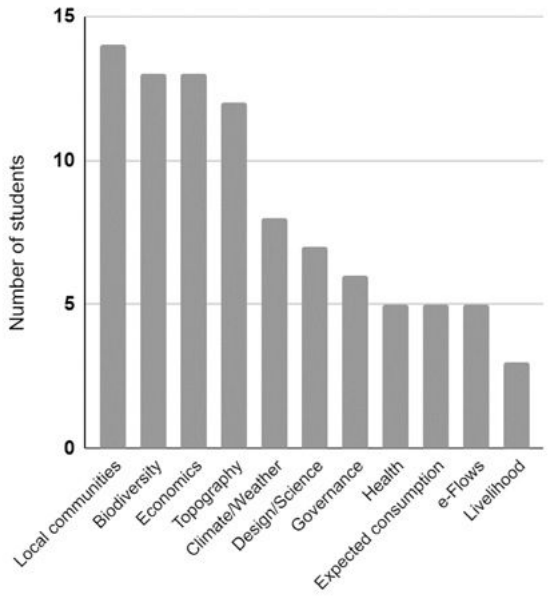


Figure 4.18. Student answers to factors which are important to consider while planning hydroelectric power plants
Source: TESF-LWM Water Classrooms project team, 2022

When we asked the students which factors are important to consider while designing a hydroelectric power plant, the answers from each student presented an interdisciplinary approach to problem-solving. They brought up aspects of different disciplines (Figure 4.18) including science, humanities, social science, and environment. They listed a variety of stakeholders they would consult for such a project—local communities, investors, consumers, architects, construction companies, water and electricity boards, labour, economists, ecologists, fishermen. These could be from either government or private sectors, or NGOs.

Overall, these sessions allowed the students to become a part of the learning process by generating knowledge within the classrooms. They experienced stakeholder conflicts and negotiations and demonstrated interdisciplinary thinking and empathy towards problem-solving. Such skills and the understanding of social institutions and systems, and conflicts and negotiations are essential components of education for sustainable development.

4.4 Through the Lens of Science

We looked at various scientific aspects of water through theory, experimentation, laboratory visits and interactions with scientists at IISER Pune during the sessions on wastewater, agriculture, and climate.

4.4.1 Exploring water through experiments

We listed the physical properties of water in the very first session about water and 'my'self and how these properties allow us to interact with water in different ways such as surface tension and washing clothes, buoyancy and travel, and density and life under water.

In a subsequent session we provided students with pH strips and a protocol to measure the pH of water around them. They selected three water samples of their choice including tap water, lemon juice or detergent, and one more sample - students selected water from puddles, borewells, a nearby pond, or other places. They then prepared a (scientific report) of their experiments and findings (Figure 4.19).

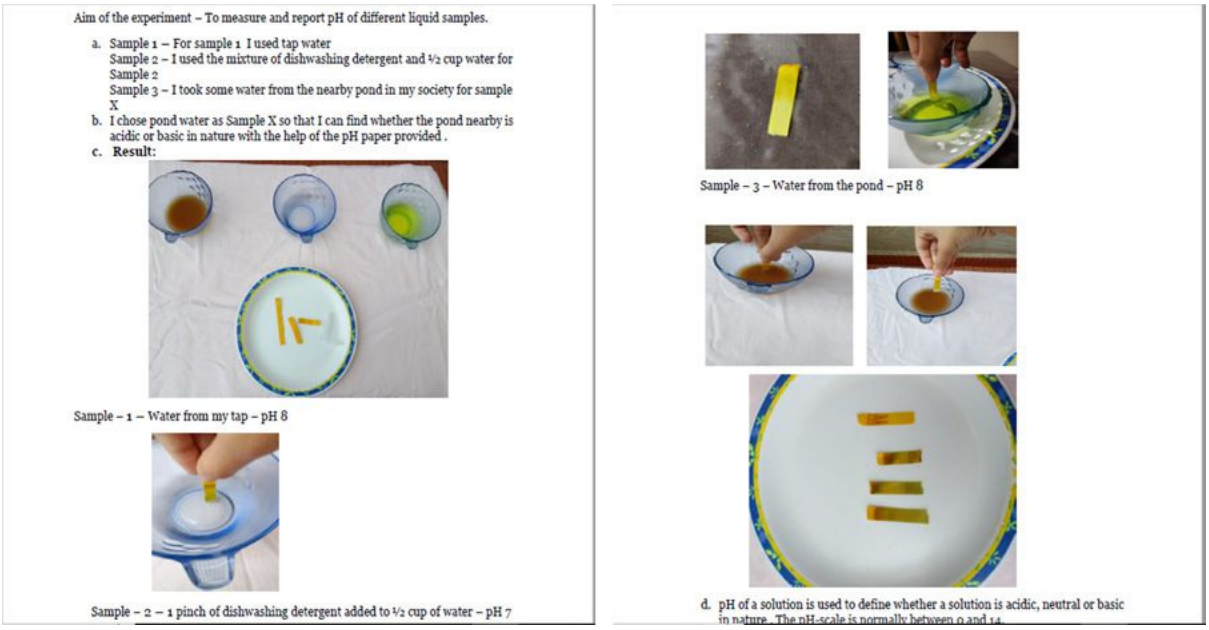


Figure 4.19. Students selected water samples, measured pH, and reported their findings | Source: TESF-LWM Water Classrooms student participants, 2022

We conducted an activity to understand the water-holding capacity of different kinds of soils and how that may affect cropping patterns and irrigation (Figure 4.20 A and B). During this we also discussed the setup variabilities and protocol standardisations that are required in scientific experiments such as pre-treatment and analysis of the soil being tested and arrangement of the apparatus.

Figure 4.20. (A) and (B) Students conducting the experiment for water holding capacity of a soil for soils from Pune, Bangalore, and Delhi; (C) Students collectively developing a mural to demonstrate the different light zones and biodiversity in the oceans

Source: TESF-LWM Water Classrooms project team, 2022

In the session about "Oceans and Us", we used a simple colouring activity in which the students collectively developed a mural demonstrating the different light zones in the oceans and the extensive marine biodiversity (Figure 4.20C). One activity involving dissolving chalk in vinegar facilitated the discussion on how the lowering pH of oceans as a result of increased pollutants harms animals with shells disrupting the life cycle of the oceans.

During the session on climate, students visited laboratories that study climate at the Earth and Climate Sciences department at IISER Pune. They were shown how rainfall patterns over millions of years can be studied through tree rings and how the mineral concentration of fossils of shelled organisms can help estimate the water levels of the oceans (Figure 4.21).

Figure 4.21. Students examining (A) tree rings and (B) fossils used to study climate in laboratories at IISER Pune

Source: TESF-LWM Water Classrooms project team, 2022

4.4.2 How scientists look at climate

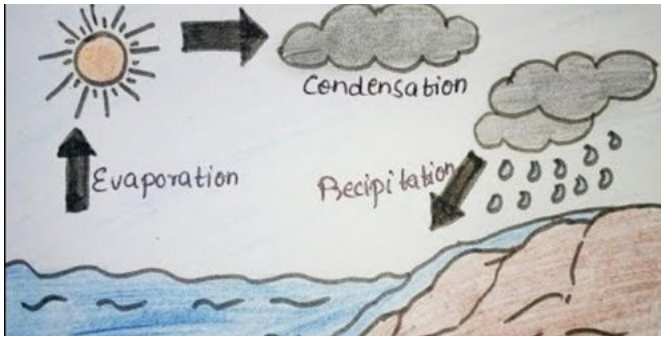


Figure 4.22. Classic representation of the water cycle as drawn by most students while signing up for the Water Classrooms

Source: TESF-LWM Water Classrooms student participant, 2022

The water cycle forms the very basis of understanding the relationship between water and climate. The classic representation of the water cycle as drawn by most students at the beginning of the session (Figure 4.22) is minimalistic and does not support the critical thinking required to address the problems of climate change. Furthermore, such water cycle diagrams are not easy to extend to the complex modes of water extraction, processing, and discharge that we observe in urban and agricultural ecosystems. A well-known framework within which to understand the water cycle is systems thinking, where the water cycle is conceived of as a number of stocks of water connected by flows. Systems thinking is useful to conceptualise and understand other complex systems involving flow of materials and energy, and therefore we decided to use this session to introduce students to systems thinking.

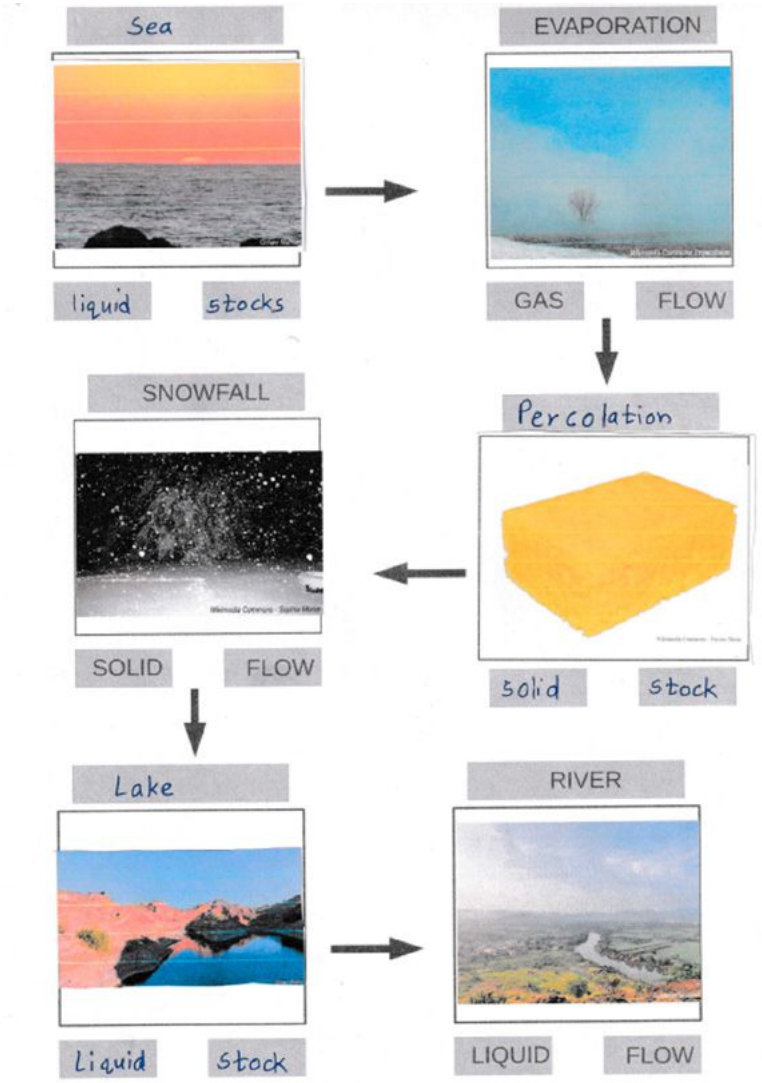


Figure 4.23. Example of one of the exercises where the students were asked to trace the flow of water across different stocks and flows. Visualising the flow of groundwater is challenging and this is reflected in this worksheet where the student demonstrated non-clarity about the association of percolation and groundwater and rivers

Source: TESF-LWM Water Classrooms project team and student participants, 2022

The session first introduced students to the difference between weather and climate and highlighted the fact that since climate is a long-term phenomenon, it must be sustained by continuous flows of energy and water. The question of sustaining flows of water over decades introduced the idea of stocks of water in the oceans and over and below the land surface, and how these must be connected to each other. Pictures of a variety of stocks and flows were provided to the students along with an incomplete water cycle and they were required to paste intermediate stocks and flows to form a realistic path from the beginning to the end. Figure 4.23 shows an example.

The artworks submitted by some of the students after the sessions demonstrated that students were able to reimagine the water cycle. They brought in the hydrosocial elements considered important in teaching water and climate (Farnum et al., 2018) but are not usually addressed through the school

curriculum. For example, Figure 4.24A showed that wastewater from pipes and wastewater treatment plants introduces complexities in the water cycle that the classic water cycle does not address. Figure 4.24B demonstrates that human interventions such as dug wells, borewells, and handpumps expose groundwater to the surface in places other than the springs. This makes groundwater accessible to the water cycle through natural as well as human-made processes.

Figure 4.24. (A) Wastewater as a part of the water cycle; (B) Groundwater extraction impacts the water cycle

Source: TESF-LWM Water Classrooms student participants, 2022

These activities and sessions helped make students see how science naturally intercalates with social elements around them. Starting from their kitchens and backyards, they could explore the world around them systematically.

CHAPTER 5: OUTPUTS AND CONCLUSION

5.1 Project Outputs

As per the project proposal, we had planned to produce teaching plans for a water curriculum that can be accessed by anyone interested in water education. We had planned to draft a policy and set up an exhibition-of-learning to showcase student experiences and our interpretations of the process during the workshops. In order to build interaction and learning spaces for the teachers engaged with us, we conceptualised and implemented an online discussion series. In addition to the planned outputs, the project PI engaged with the TESF Mojo and is developing a short movie about the project. The current status of the outputs are detailed below.

5.1.1 Teaching plans

We have developed teaching plans for 18 of the 19 topics mentioned in the course outline in section 3.2. Since these topics were highly interdisciplinary, no one person could determine the content requirement for these lesson plans. So, we reached out to several subject matter experts (SMEs) to contribute to the content requirements. It was, however, not always feasible for the subject matter experts to write all the sections of the teaching plan or contribute the visuals and activities (refer to the teaching plan template in Appendix D). A large amount of visual information was curated by the project team from the repository available at the Living Waters Museum or those existing in the public domain. Students and educators, especially Aakriti Parashar and Darab Nagarwalla, made immense contributions to activity design. Learning outcomes, success criteria, and use of time were finalised in close consultation with the project PI. SMEs, educators, or the project team contributed to other aspects of the teaching plan on a per case basis.

Finalised teaching plans can be accessed **here**. The teaching plan for water and the arts was tested during the exhibition (section 5.1.2). Topics related to water and action were incorporated in other teaching plans mentioned earlier.

5.1.2 Exhibition-of-learning

In some sessions we used art as a teaching and evaluation tool, e.g., WC-1-2. At the end of the workshops, we asked students to use their artform of choice to describe what they learnt from the sessions. Students were guided by the project PI on how to approach this exercise and their participation was voluntary. Some of them drew images, made models, or wrote poems and stories. We used the illustrators in our network to illustrate the written pieces. This artwork along with images from the workshops and data analysis was curated for an exhibition on 19 February 2023, at IISER Pune (Figure 5.1). The exhibition was accompanied by science demonstrations by the Science Activity Centre and the Department of Biology (IISER Pune) and a conversation on Water and the Arts by Sukrit Sen. The exhibition was also available for public viewing on the National Science Day, celebrated at IISER Pune and attended by students and parents across the city. The digital version of the exhibition can presently be accessed **here**. We request that any reproduction of these images should credit the student artist and acknowledge the Living Waters Museum.

Figure 5.1. Glimpses of the exhibition-of-learning Ripples: Reimagining learning on Water, held at IISER Pune on 19 February 2023. Curated by Chhavi Mathur, Ritvee Talele and Sara Ahmed | Source: TESF-LWM Water Classrooms project team, 2022

5.1.3 Online discussion series

In order to make available a platform where the participating teachers can engage and participate in the current discourse on sustainability, we conceptualised an online discussion series—Unravelling Sustainability. The premise of the series is as follows:

Following the United Nations' attempts to address environmental concerns in the 1960s and 1970s, there have been multiple attempts to define sustainability. It is estimated that nearly 300 definitions of sustainability exist within the environmental domain. This is indicative of the inherent complexity of conceptualising sustainability and, eventually, its articulation, communication, and implementation. As the UN devised 17 Sustainable Development Goals (SDGs) in 2015, education for sustainable development (ESD) was seen as the principal way of guiding youth towards sustainable and resilient futures. ESD cuts across various disciplines and incorporates basic concepts such as social justice, equality, and environmental protection. Studies have shown that educators often understand the ecological, geographical, and historical perspectives of sustainability better than its social and economic dimensions. Due to the subject's complexity and the limitations of the education process, integrating sustainability in existing pedagogies from a holistic and transdisciplinary perspective has been challenging (Little, 2014; Uitto & Saloranta, 2017; Kougias et al., 2022).[14,15]

[14] https://www.epa.gov/sites/default/files/2014-10/documents/framework-for-sustainability-indicators-at-epa.pdf

[15] https://sdgs.un.org/2030agenda

Figure 5.2. Announcements for the talk series | Source: TESF-LWM Water Classrooms project team, 2022

This online talk series was conceptualised for educators from middle and high schools to engage with professionals working within various sustainability frameworks and explore ways to integrate ESD tools and competencies within their practices.

We invited several speakers working with environment and education (Figure 5.2) to speak in this series. Appendix E has details of the speakers and talks, and the talks can be accessed **here**. Primarily aimed at educators involved in the project, the talks were also made accessible to professionals and to students at IISER Pune. Hence, the audience drawn to the talks was a mixed crowd which enriched the discussions after the talks. Teachers appreciated the talk series since it helped them gain perspective on how concepts discussed under sustainability frameworks are realised on the ground and the challenges faced during implementation.

The talks struck a balance between conceptual formulation and practical challenges to their implementation. As due focus was put on education in the light of sustainability, the ideas discussed in the talks displayed a common theme—the need to shift away from current paradigms of education. As noted by Prof. Poonam Batra in her talk, incorporating sustainability ideas implies "fitting into" the current model. This may not be as effective in attaining the SDGs as the present framework and policy of education fail to address the many facets of our social institutions and challenges. However, as exemplified by Dr Deborah Dutta and Samira Mukherjee's work on food gardens in schools, it is not impossible to supplement the current curriculum with opportunities for the students to initiate conversations around ideas of sustainability and experiment with them. However, the activities need to be guided to break out of the shackles of the formal classroom. Some of the talks—like those by Darab Nagarwalla, Disha Chauhan, and Minaz Ansari—provided tools to educators to improve the classroom experience and explore more avenues within the current curriculum. Minal Sagare talked about how the understanding of the traditional and modern within the local context could inform the approach towards a sustainable future through practice and education.

There is a considerable gap between SDGs and the current framework. Interventions are required at the policy level to enact frameworks, but it is also essential to change the perspective of the stakeholders in the sphere of education to introspect and innovate in classrooms. Any attempt at sustainability must address future needs and reserve enough flexibility to accommodate them. Participants have repeatedly suggested that avenues akin to the current project that brings together professionals and stakeholders from various fields need to be created more often to facilitate well-rounded conversations around sustainability. The discussions in this talk series provide solid starting points for more conversations in the classroom to inspire young minds for a sustainable and resilient future.

5.1.4 Policy brief

The policy brief recommends including place-based, multidisciplinary pedagogies in the frameworks of education for sustainable future. These must be co-created by diverse stakeholders including the educators and museums. It suggests to focus on the subject matter as well as skill building such as systems thinking, problem-solving, and negotiation to equip students to reimagine a sustainable future. The policy document authored by Chhavi Mathur, Joy Merwin Monterio, Sara Ahmed, and Aakriti Parashar can be accessed **here**.

5.1.5 TESF Mojo Video

During the project year, the project PI enrolled in the video-making sessions conducted by TESF Mojo. It was an interesting learning experience enriched by watching the movies for various projects across TESF hubs.

The final draft of the movie for the Water Classrooms project is about 4 minutes long. The movie describes why this project was undertaken, the process, and the transformation of various stakeholders involved in co-creating this experimental pedagogy. The movie is now available at this **link**.

5.2 Sharing and Institutionalisation

The work done in this project was shared with the Dakshinachitra Heritage museum in Pondicherry by Dr. Sara Ahmed. Sukrit Sen, who wrote the teaching plan on Water and the Arts, conducted the session with school students and teachers in Pondicherry which was well received.

The project PI was invited to conduct one of the sessions with the master's students of Ecology and Environment at the Centre for Technology Alternatives for Rural Areas (CTARA) at the Indian Institute of Technology, Bombay. She talked about the work done in the project at CTARA and the Industrial Design Centre School of Design at IIT Bombay.

The project has significant institutional support from the Living Waters Museum, Science Activity Centre, and the Centre for Environment Education. The content has several prospects for institutionalisation via these organisations. Dr Sara Ahmed is also an advisor at the Jal Shakti ministry for the project looking at water museums and education in the country. Participating educators can also serve as pathways for institutionalising some of the ideas of the project in the curriculum or in extracurricular spaces.

One of the participating schools has expressed interest in taking the Water Classrooms project to a larger group of their students across the five schools under their administration. Teachers were also keen to know the future direction of this project.

5.3 Conclusion

As the new National Education Policy 2022 encourages interdisciplinary education in schools, water is an excellent example for inter/transdisciplinary conversations and learning which cut across all disciplines. ESD seeks to produce learning outcomes that include core competencies such as critical cross-disciplinary analysis and systems thinking, collaborative decision-making, and taking responsibility for present and future generations. In concurrence with these vision statements, teaching plans developed and implemented under this Water Classrooms project have been found to offer the following features integrated within the pedagogical framework:

- They are interdisciplinary to include not only the physical and scientific aspects of water but also social relations that influence access to water such as gender, caste, and power structures.
- They are student-centred and inquiry based.
- They use visual, interactive, and experiential learning and provide learners with the space to reflect on their experiences.
- They encourage students to look at the world around them, problematise environmental concerns, and engage in informed and multidimensional problem-solving.
- They inculcate the understanding of water from a local as well as a global perspective.
- They provide a platform to promote empathy building and a culture of dialogue amongst learners.

Development of an extensive knowledge repository of Pune's waterscapes and its dissemination through water classrooms intends to allow students to look at their own sinks, backyards, and localities, and understand waters around them. This will help build better observational skills which can lead to better problem-solving at individual and local levels.

Pune city has always been influenced by the water landscape of the larger Pune district. While it earlier influenced the development of the city's historical water systems, today, water-related disasters around Pune affect the social and economic fabric of the city. Understanding this relationship of oneself with the larger region or basin/watershed where one is located is important for policy-related conversations.

Inculcation of the various skills and competencies required by ESD will be crucial to enable learners to address interconnected global and local water challenges including climate change, environmental degradation, loss of biodiversity, poverty, and inequality, and likely build agency which could promote reflective action. We hope that these are used and adapted widely, and foster the student and teacher agency and competencies needed to close the knowledge-action gap towards sustainable futures through education, negotiation, and implementation. We have found that the level of the sessions can be adapted to the level of students if the discussions after the activity are tailored as required. Some activities could be conducted successfully with middle school students as well as undergraduate students.

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APPENDIX A

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4. Rifa Meddapil – social media and design, workshop organisation
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APPENDIX B

Educator Responses: Water Classrooms

We used a Google form survey to tell educators about the Water classrooms project and ask if they were willing to participate and address a few questions regarding water education in middle school in Pune, India. The form was filled by a few interested teachers whose narratives are given below.

Q1. In your opinion, once a student passes middle school, which aspects of Water will they know best?

Educator narratives

“The students will come to know the uses , sources of water on the Earth. They will come to know the causes of scarcity of water, causes of Water pollution so that by taking preventing measures , they can minimize water pollution.”

“Wise use of water”

“The components”

“They will understand value of water.”

“Sources of water, method of purification of water,scarcity of water in some parts of IN. Water harvesting.”

"Water cycle, monsoon, surface waterbodies especially names of major rivers, physical and chemical properties, different uses of water (domestic, agriculture, industry)"

"Conservation"

"The syllabus touches water in many ways. Basic ecology, pond ecosystem, erosion and weathering, the water cycle.. list is quite huge. In my opinion, rather than just informing them, we should be making the children interested in water in a multidisciplinary way."

Q2. Do students conduct or see demos for any water-related experiments at school? If yes, which ones.

Educator narratives

"Water exerts pressure, Osmosis, Evaporation, transpiration"

"There are experiments prescribed at middle school level."

"Physical and chemical properties of water"

"Water filteration"

"Last two years have been online. So hardly any projects and experiments. We did see films online about biodiversity. And some episodes were about journeys of Himalayan rivers, episodes on life in India's seas and mangroves. We also saw films on restoration of traditional water storage tanks in rajasthan when we were studying deserts. Some older children did projects and dams was one of the topics. The children came across questions like - Are small dams better than large ones , effects of dams on habitats and people's lifestyles etc.."

Q3. Do students learn about water and sustainability in middle school? If yes, please explain what and how.

Educator narratives

"How to save water consumption? How to minimize water pollution?"

"Yes, through skits and various awareness programmes"

"About water yes. But about sustainability not much."

"A little perhaps, about not wasting water"

"Water is touched upon indirectly in many topics. For eg. A lot of the syllabus is about different regions, so how people adapt their lifestyle to the landscape is discussed a lot and water is a major factor. Children also have chapters on pollution, waste management , natural disasters. Sustainability is not taught as a topic . Children have some general idea about it from various information sources."

Q4. In your opinion, how can we transform the current water education to prepare students for a sustainable, resilient, and just water futures?

Educator narratives

"We can arrange study tours to observe Water purification plants..make them realize that tap water is processed water and money is invested for that..so how can we waste such a processed tap water? About Car washing, we can make them aware about wastage of water. Rainwater harvesting importance, we should explain to them. Give training to reuse household clear water."

"Make them understand the importance of water"

"By conducting experiments and workshops."

"By taking them to villages and show how scares is water. By teaching them water conservation techniques."

"Suggestions and material for teachers to support locale-specific application of the students' conceptual understanding about water. Addition of concepts such as:

1. water-food-energy interlinkages

2. gender aspects of water and sanitation

2. inspirational, contemporary stories / case studies of sustainable water management "

"By including more activities"

"I like to focus more on showing children the interconnections in nature. To see how these effect us . To generate gratitude and wonder towards nature which would lead to respect and conservation naturally , not from a space of scarcity and fear. This is the way i would treat the subject of water sustainability."

APPENDIX C

Capacity Development and Challenges Faced

Capacity development

The project drew on the PI's expertise in understanding water from scientific, physical, and biochemical perspectives, experience in building research programmes and management, visual storytelling, and research grant and report writing.

During the first half of the project, she gained experience developing an education research programme in environmental studies focussing on water. Her collaboration with Dr Sara Ahmed helped make the project more interdisciplinary, bringing in Sara's expertise on social, cultural, and equity perspectives on water. Using Living Waters Museum's and Centre for Water Research (IISER Pune)'s network, the PI developed a network of people willing to contribute to the project with knowledge of different aspects of water such as those working with water, climate, biodiversity, equity, justice, heritage, disaster management, arts, storytelling, data science, and education. She gained experience conceiving, developing, managing (including funds), and planning the execution of a truly interdisciplinary program.

The PI as well as the other subject matter experts learnt how to methodically write teaching plans (for middle school students) which are student-centred and inquiry based and also visual and interactive.

Through discussions with educators, the research team learnt how to design learning objectives, learning outcomes and assessment rubrics. Through the Science Activity Centre (IISER Pune), Centre for Environment Education and Pune Knowledge Cluster, the PI was connected with several schoolteachers.

Schoolteachers brought in their knowledge of student participation, practicality of teaching plans, and ideas for activities and logistics. They got the opportunity to co-create inquiry based and interactive teaching plans based on an environment essential—water—from an interdisciplinary perspective, and to interact with subject matter experts. They interacted with various stakeholders in conversation around sustainability (and) education during the talk series organised as a part of the project.

Undergraduate student volunteers brought their management skills, writing skills, ideas for activities, student perspectives, and energy to the project. They got an opportunity to be part of a real-life research project in education through literature survey, textbook analysis, developing methodology for data collection, survey design, handling visual elements (including licensing considerations), developing activity sheets, and organisation of the exhibition.

Collective narrative of the undergraduate student interns: "*Offering a unique and fruitful experience to its student volunteers and interns, the Water Classrooms provided a one-of-a-kind opportunity for them to gain a wide range of skills. While working on the talk series and classroom material, they learnt to look through literature and to adapt the contents according to the theme of the project. This helped them*

acquire the skills of research, qualitative data analysis and networking, which will be helpful in their future academic pursuits. While working with visual and auditory media, volunteers gained hands-on experience capturing a wide range of people and their narratives.

Learning all this didn't come without challenges. At the beginning of this project, the students were not entirely familiar with any skills that would be required, such as networking, camera handling, organising [workshops]. With extensive support from the PI, other students, participating teachers and educators, it became easier for them to overcome this challenge of inexperience. Team building activities like dining together, interacting informally during tea breaks and helping each other set up the classroom environment not only encouraged professional development but also created familial bonds to be cherished forever."

In the process, everyone is learning more about Pune's water, issues around it, and opening the discussions around how we can facilitate solutions from an interdisciplinary perspective. Understanding this in the local context also helps learn how to approach such subjects in a holistic manner at a global level.

Some of the research team is attending the mobile movie making course organised by TESF network and learning new ways to communicate through the visual media.

Moving forward with challenges

Examples of some of the challenges with capacity strengthening and mobilisation and their navigation are as follows:

1. Building relationships with educators and middle school students has been a difficult task. Several educators contacted between February and March 2022 responded to us only in May–June 2022 due to existing personal and professional commitments. Assistance and contacts provided by education experts at Science Activity Centre (SAC), Centre for Environment Education, and Pune Knowledge Cluster have enabled these relationships to form. The project PI was asked to speak at one of the workshops conducted by SAC. This exchange allowed for more organic relationships to develop with the educators.

2. Maintaining timelines in the project has been a challenge in such large collaborative projects. Timelines for submission of teaching plans were often not met. This was as much due to the lack of time as it was due to unawareness of how to bridge the communication gap between an expert and a middle school student. This gap was bridged to a large extent when we conducted the talk by Darab Nagarwalla (a participating educator) who introduced the research team and subject matter experts to approaches of developing learning objectives, learning outcomes, and rubrics.

   It was clear that constant follow-ups, defining clear deliverables and expectations and clear communication were required to have productive collaborations. The number of people that the PI ended up working with and managing is much more than was anticipated while setting up the project. This was important to bring in the diversity of experience and expertise required to support the multidisciplinary nature of the project, but it also requires more time and entails higher transaction costs (human resource management).

3. Understanding and following the processes at LWM and TESF have helped enhance skills towards building and maintaining partnerships, although the funding arrangements made it challenging to navigate administrative issues across partners. Regular reporting has helped assess progress objectively and clearly define next steps.

4. Encouraging undergraduate students to think about the bigger picture, indulge in exploration and problem-solving, following a methodical, scientific research process, attention to detail all need constant feedback and engagement with students. Some are able to understand this manner of working. For those who don't, the PI has to identify their strengths and design ways for them to be productive and explore their potential in different ways. This training process leads to delays in project progress but are necessary for capacity building of the team. Striking this balance can be a challenge for the PI.

5. The project PI faced health-related issues—COVID-19 and injury—leading to unprecedented delays in the project. However, the team has managed to conduct the majority of the proposed activities. The project required additional time (a no-cost extension) to finalise the outputs.

APPENDIX D

Teaching Plan Template

(Adapted from Pani Pahar curriculum with consultation with educators in the project)
Sections in red were the major responsibility of the subject matter expert.
The other sections (black) were often written by the PI or student interns or other content writers.

Lesson Plan Number	
Topic	
Discipline	
Time	
Prior Learning	
Learning Objectives	
Success Criteria	
Resources for Main Activities	

Key Vocabulary	
Use of Teaching Time	
Differentiation	
Additional Activities (optional)	
Assessment - Observation, Measurement, Evaluation, Reporting	
Anticipated Challenges and Solutions	

Keywords:

Definitions (if any):

Description of the content (max 1500 words):

To be written by an expert

Additional reading/reference material (10 max):

To be written by an expert in the field

Worksheet/Activity sheet/Guidelines for an activity/...

Developed by undergraduate students and project PI in consultation with the expert.

To be started on a new page - Drafted in a way that it can be directly printed and used by an educator/facilitator.

APPENDIX E

Discussion Series: Unravelling Sustainability (and) Education

The discussion series was jointly conceptualised, curated and coordinated by Manav Sivaram and the project PI. Creatives for the series were created by Rifa Suhaz. The details of the talks and the speakers are given below:

Learning outcomes and rubrics – Darab Nagarwalla

Abstract: While designing a lesson, educators often get excited over an activity to teach a topic and then try to figure out what their students will learn from it. Often, this leaves a gap between the expectations of the teacher and what the students actually learn. Also, students are typically assessed only on one axis - that of content assimilation, with a numerical score or percentage. The motivated student can only try to guess what this score means to their learning experience- where their strengths lie and what areas they need to improve.

In the two-part talk, Darab Nagarwalla gives a clearer picture of the expectation gap and how to resolve it. Working on some examples, he demonstrates how to design a lesson starting with the learning outcomes and working "backwards" to the activity. He also unpacks how rubrics can be powerful tools for assessing students and is more helpful in providing constructive feedback.
Darab Nagarwalla, Manav Sivaram

About the speaker:
Darab Nagarwalla obtained a BSc in environmental studies from Northland College, Wisconsin. He worked for 17 years with NGOs working on resolving issues of environmental degradation and livelihoods with village communities of Saurashtra and later in Kumaon and Garhwal in Uttarakhand. He then reinvented himself as an outdoor and environmental educator and later trained and licensed as a science teacher. He is passionate about the outdoors as a great teaching tool and the need to connect theory with relevant, real-life concerns and experiences. He also has a natural affinity, in his own words, with the lovable craziness of the world of middle school students.

Links to the talks:Part 1: https://youtu.be/KiNfphL3Jvw
Part 2: https://youtu.be/D9Jfo3FhNgU

Storytelling in education – Disha Chauhan and Minaz Ansari

Abstract: Stories can make abstract and multi-faceted concepts more accessible and enable students to assimilate complex ideas and build on them. In this talk, we explore how storytelling can be used in a classroom to engage students in conversations around sustainable futures. The talk looked through children's storybooks which can be used to examine our water practices - cultural and ecological - and discuss other resources that educators could use in their classrooms.

About the speakers:
Disha Chauhan is a neurobiologist, artist & illustrator. Her close kinship with nature as a child, directed her towards science and the arts. She works with different mediums on various themes with a focus on nature, people & science, trying to understand their relationships through their stories.

Minaz Ansari is an architect and urban designer, teacher and explorer. She designs, researches, mentors and writes. Fascinated by the magic of storytelling, she attempts to incorporate storytelling as a tool in her interactions with students at Rizvi College of Architecture, where she is a Professor. She has authored “Nesting In Nature - Sanjay Patil”, a monograph on the architect’s works, and “Paani Party”, a children’s picture storybook to create awareness around water.

Link to the talk: https://youtu.be/m6I7Zo3Qi0g

Understanding sustainability in the 21st Century – Dr Priyadarshini Karve

Abstract: Although the concept of sustainability was coined more than three decades ago, we are still short of an operationalisable definition. Attempts have been made to understand sustainability using different frameworks. Broadly, the stakeholders have been delineated as the environment, economy and society (also referred to as the “three pillars” of sustainability). While some of these frameworks provide qualitative goals, many attempts to provide quantitative indicators to mark the progress of sustainability at local and global scales.

The speaker gave an overview of sustainability frameworks on a global scale using select indicators. A comparison of such indicators allows an understanding of sustainability from a holistic perspective and enables the stakeholders to derive their own roles, responsibilities and capacities towards just and sustainable futures, especially from a water lens.

About the speaker:
Dr Priyadarshini Karve completed her PhD in Physics from the University of Pune in 1998. Her first research project developed a process for converting agricultural waste into charcoal. The technology won the Ashden Award for Renewable Energy in 2002.

In the past 10 years, her work has focused on devising and promoting low-carbon, sustainable urbanisation strategies. A contributor to peer-reviewed journals and technical books, she is also the co-founder of OrjaBox LLP, a green start-up since 2021. She is actively involved in organisations working in renewable energy, climate resilience, equitable, sustainable development, etc. She is a founder-member of the BoD of the Clean Energy Access Network and the National Convener of the Indian Network on Ethics and Climate Change.

Her work has been honoured by several national and international awards, including the World Technology Award in Environment category in 2005 and Sahyadri Hirakani Award in 2011.

Link to the talk: https://youtu.be/rZQDGoC4DKE

Sowing seeds of hope: Food gardens in schools – Dr Deborah Dutta and Samira Mukherjee

Abstract: Schools form an integral part of the community. Providing students with authentic experiences to engage with the local environment allows diverse ecological practices to emerge from the activities. However, the notion of experience tends to get simplified and uncritical within the structure of formal education. Many activities, primarily meant to nurture environmental sensibilities, tend to be tokenistic actions (planting saplings on Earth day, making "Save the Tiger" posters etc.) without the possibility of any feedback or consequence. On the other hand, textbooks are filled with bleak scenarios of environmental degradation, thus leaving the students acutely aware of the "big" problems but disempowered to bring about any transformation in their locality.

Many educators have thus argued for the need for "authentic participation" where students feel empowered and responsible for initiating change in their localities. Combining the ideas of 'authentic participation' with practice possibilities of terrace farming, eighth graders from a CBSE school were involved in setting up an edible farm at their school terrace. This talk explores the potential and challenges of setting up such spaces through an interactive discussion with the project facilitator and the schoolteacher.
Dr Deborah Dutta

About the speakers:
Samira Mukherjee is an educator with more than two decades of experience as a primary and middle school teacher. She is a passionate advocate of outdoor teaching and is an avid gardener.

Deborah Dutta is a researcher with a PhD in Science Education. She is interested in designing immersive learning environments, understanding socio-technical systems and developing theories of motivation underlying collective action.

Link to the talk: https://youtu.be/7t5YA6fdtZ0

Possibilities and challenges of sustainability frameworks in curriculum and pedagogy – Prof Poonam Batra

Abstract: The need for quality education for sustainable futures is recognized as a Sustainable Development Goal (SDG). Although education is interrelated with every SDG, our education systems still struggle to integrate sustainability within the curricula. The curriculum at the high school level addresses the environment but fails to provide a clear and functional understanding of the scientific, social, and economic aspects of climate change. It also lacks the historical context of the problem of sustainability. The National Education Policy (NEP) 2020 suggests addressing the issues surrounding sustainability from a multi-dimensional and interdisciplinary lens.

In this talk, Dr Batra addresses how different aspects of sustainability could be incorporated into the existing curricula. She will also talk about the philosophical and operational constraints on this and how to think about solutions in such cases.

About the speaker: Poonam Batra is a Professor of Education, formerly with the Central Institute of Education, University of Delhi, India. Her work spans multiple areas of knowledge: public policy in education, curriculum and pedagogy; social psychology of education, teacher education and gender studies. Professor Batra was a Nehru Memorial Fellow, a member of the Indian Supreme Court's Commission on Teacher Education and co-author of key education policy documents. Her recent research examines coloniality in the episteme of Indian educational reform, comparative education imperatives, and the politics of school and teacher education reform. She is Co-I and India lead on the GCRF Transforming Education for Sustainable Futures (TESF) project.

Link to the talk: https://youtu.be/iwvoqj50I5A

Towards a new water culture – Minal Sagare

Abstract: Colonial and postcolonial development models in India have often ignored traditional and local water management systems, as well as the water culture these systems had shaped. The choices made during urbanisation and infrastructure development severely dismantled the nexus between ecology, economy and community in the traditional water management systems. These decisions have weakened the water culture and increased the vulnerability of the region towards climate change. Chennai and the evolution of its water management systems from *ery/eri* and Temple tanks to modern pipeline infrastructure is a case in point. The traditional water management system in Chennai was rooted in the geography of Chennai, mirroring its hydrology. The shift to urban models has depleted the groundwater in Chennai due to increasing water demands. On the other hand, instances of urban flooding have also increased. Set against this backdrop, this interactive session is aimed at collectively thinking about a new water culture in various contexts.

About the speaker: Minal Sagare is an architect and urban designer based in Pune. She has a keen interest in the core questions of the architecture and design of human habitations. She is equally engaged in exploring the multidisciplinary ties of architecture and urban design. Along with academics and practice, she is involved in various research assignments. She is a faculty at Building Beauty India - an upcoming postgraduate program at CDSA, Pune, aimed at rekindling human awareness of the interconnectedness of living structures through ecologic design and construction process. Currently, she is pursuing her PhD at Srishti Manipal Institute of Art, Design and Technology in Banglore. Her PhD project focuses on the perception of liminal landscapes and the imagination of human habitations in the context of pre-modern cultures.

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We undertake collaborative research to Transform Education for Sustainable Futures.

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