

In this article, I am going to outline a programme we initiated to reinforce science learning and make it not only more accessible to our students but also make them aware of the process of science and scientific methodologies. The content of this article is primarily derived from my learning while working at the Azim Premji School, Uttarkashi.

A typical teaching unit

Students' questions

For a few days before beginning a topic, we would invite questions from the students and display them inside the classroom. The teacher would start by asking a leading question(s) chosen from either the students' questions and/or curated by the teacher. The teacher could demonstrate the principle being taught and ask questions related to the demonstration. The first day of the class was usually inside the classroom, though several units, such as *Waste Management, Plants and Animals Around Us, Weather and Climate, Soil, and Agriculture* were introduced outside the classroom.

In the first class, students were provided with a worksheet with both short and long answer-type questions, or a set of questions to respond to. The questions were designed for the teachers to understand the students' existing understanding of a concept and content. We developed these questions from our learning from research literature as well as our previous teaching experience on the topic.

Worksheets

Students were then introduced to a problem context and provided with a problem task in the form of a worksheet, which had two parts. In the first part, the students were required to write about their plan for solving the problem – ways of data collection and tabulation, making models and predicting the results or outcomes with their rationale.

In the second part of the worksheets, students were asked to carry out their plan and record their observation in a given format, note down their findings and a reflective note on their learning, and file a self- and peer-assessment sheet. These worksheets

were primarily developed and adapted from Homi Bhabha Centre for Science Education (HBCSE) Small Science Curriculum,¹ NCERT Textbooks, Nuffield curriculum, Eklavya's science materials, handbooks prepared by Centre for Environment Education (CEE) and Centre for Science and Environment (CSE) and pullouts of *iWonder...* (Azim Premji Foundation's science magazine) etc.

Activities

While responding to the worksheets, students were required to carry out diverse activities, such as sharing their understanding, views or thoughts in multiple forms, like essays, short answers, multiple choice answers, posters, drawings, flowcharts, mind maps, planning and carrying out investigations, experimentation and measurements, surveys, literature review, interview, planning, designing and making models, etc. The worksheets included both individual and group work and had to be completed within school hours. The teacher summarised the responses of all the groups and presented them to the class.

In the teaching plan, we would keep multiple worksheets separated on the basis of teacher-led discussion and demonstration, reading, and students' group and individual presentations. Teacher-led discussions were planned to address the students' responses in the worksheet and activities conducted while responding to the worksheets. These discussions helped teachers to assess and meet students' learning needs.

Reading material

Students were provided with a diverse range of readings from publications such as Eklavya, NBT, CBT, NCERT, HBCSE, Pratham, Tulika, Katha, Vigyan Prasar, CEE, CSE, Muskan, Bharat Gyan Vigyan and Takshila etc. Sometimes, students are also provided with selected articles from Chakmak, Science Reporter, and pullouts from *iWonder...* Students are given questionnaires to fill out, based on the books they read. The learning from the readings was also discussed in open sessions. Several times, students got their answers while reading the resources.

Sometimes, teachers also prepared handouts for students to supplement their reading.

More student questions

As the teaching progressed, students wrote more questions and displayed them in the classroom and at the same time, they ticked off those that had been answered. We also displayed students' work as resources for other topics and for teaching in other classes. These were presented in the assembly, PTMs, bi-monthly *Baal Shodh Mela*, and other celebrations at school.

Project work

At the end of each of the teaching units, students filled in a questionnaire, took part in a quiz they prepared themselves, or wrote an essay based on set questions. For some topics, a worksheet was designed to carry out a full-fledged project. These projects were completed under teachers' supervision at school. In the classroom, the teacher would introduce the context and the expectations from students; help in planning the work and develop assessment schemes through consultation with students. Teachers would provide cognitive as well as material support while students carried out the project. Some of the projects included community work, like cleaning or planting trees at a selected common community area, running an awareness programme on a communicable disease, etc. Some of these works are submitted for the Children Science Congress and INSPIRE awards-MANAK.ⁱⁱ

Learning outcomes

Overall, the teaching units are structured in a way that students could progress in the learning outcomes specified by NCERT and 21st Century Skills.ⁱⁱⁱ We used our judgment to decide which concepts students could learn in their context and how these concepts could be built from their everyday experiences. For this, along with using students' everyday context, we designed activities that could simulate experiences that can be expected in other contexts. The teaching units are planned in a way so that the topics would integrate more than one chapter of the textbook of one or more than one subject. In other words, subjects and concepts are integrated while teaching the unit. This integration of subjects and multiple concepts is easier when we ask students to solve real-world problems, expect diverse work student productions, and present their work to real-world audiences for real purposes.

Making science learning joyful

Science learning becomes joyful when students comprehend the content and concepts, feel valued, their questions are addressed, and they are able to actively participate in the learning of science. Conducting projects by integrating multiple subjects and concepts makes content and concepts relatable to students. Completing these projects in a resource-rich environment helps students engage meaningfully, provides their work a sense of value and gives them a sense of accomplishment. Organising teaching around a real-world purpose in an environment where students and teachers work collaboratively, gives students a sense of social endeavour.

We thought that students would learn science with joy if they were immersed in an environment where they felt as if they were working as scientists. The classroom was made to resemble a science lab by doing the following:

- Pasting charts, posters, samples (bones of dead animals, teeth, stones, old equipment) and work produced by students, etc. on the classroom walls
- Maintaining a classroom library of science books and reading materials
- Placing materials required for conducting experiments related to science in the classroom
- Displaying small ongoing experiments, working models, and maintaining living species in the classroom

Summary and the way forward

We realised early that the Learning Outcomes specified by NCERT would not be met unless the pedagogy is not diversified. At the same time, the resources had to be made handy and amenable to manipulation by students and teachers. Therefore, the classroom was designed as a laboratory and library. Many topics were related to plants, animals, and agriculture, so a lot of greenery was added to the school environment.

- Science and Eco clubs were established, and students took on the responsibility of making the school eco-friendly and contributing to community work. These engagements were integrated directly with topics taught as per the syllabus and in alignment with the curriculum.

- Science classrooms were made more exploratory, focusing on designing and conducting activities based on worksheets, group work, self and peer assessment, and reading diverse resources related to the topic.
- Open-book exams were introduced along with worksheet-based assessments.
- Teachers did not force students to learn definitions or list examples of different types or categories in isolation.
- In most of the activities, students were required to first predict and then carry out the task to test their prediction. So, the task of assessment was a learning experience for both teachers and students.
- We did our best to scaffold students engaged in learning science.

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Endnotes

- i <https://smallscience.hbcse.tifr.res.in/>
- ii <https://www.inspireawards-dst.gov.in/>
- iii <https://www.edglossary.org/21st-century-skills/>

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