

## Beyond Four Walls: An Example of Project-Based Learning

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The National Curriculum Framework 2005, more popularly known as the NCF 2005 (NCERT, 2005) endorses a constructivist approach towards teaching and learning. The document suggests conducting projects which follow thematic and subject-integrated teaching. Though there has been an increase in project practices in the post-NCF 2005 scenario, it still remains only a half-hearted implementation of the proposal. Other papers (Shome, 2013). Shome and Natarajan (2013) have proposed a model of project-based teaching in response to the proposals made by NCF 2005.

Project-based teaching includes real world contexts, authentic problems, authentic assessments, group work by students and a culmination of students' work in a tangible form, preferably in front of an external audience (Thomas, 2000). Interestingly, recognising systemic issues NCF 2005 asks for making the school timetable flexible and responsive to students' learning needs, scope for co-teaching and collaboration among teachers of the same, or even different, subjects and whole school support in the process (NCERT, 2005).

Keeping in mind the policy directives and looking for ensuring deep learning among students, during the academic year 2018-19 we planned and executed thematic projects with students from grades 3 to 8. The projects followed several elements of project-based teaching proposed by Shome and Natarajan (2013) and Thomas (2000). These include working with problems of the real world, with real world data and content, learning core concepts of the syllabus while carrying out projects, opportunity of group work among students, whole-class projects, authentic assessments, integration of subjects, bringing in components of investigation and problem-solving, collaboration among teachers of different subjects, daily planning of teaching units, flexible timetables and extended classroom period timings. The scheme includes tangible outcomes in the form of models, presentation, experimental designs etc prepared by students. All this was to be displayed in front of an external audience at school

in a *Baal Shodh Mela*. In this article, we will present our engagements with the students of grades 5 and 7.

### Making of a school model

With twenty seven students of grade 5 we integrated three chapters of the NCERT mathematics textbook, namely, maps, solid objects and projections, area and perimeter. The idea was derived from a project-based teaching unit developed by Shome, Shastri, Khunyakari, and Natarajan (2011). Their work elaborates grade 6 students' engagement of drawing, designing and making scaled play item models for a children's park proposed on a ground of a given dimension.

In the first session, we had a discussion on sketches and maps with examples. Students were briefed on their tasks, asked to make a sketch of the school compound, including classrooms and construct a scaled model of the school compound.

Groups of two students each were formed. Each group surveyed the school compound, went to different locations and worked on making the sketch of the school. On the first day, only four groups could do the task, but on the second day, students repeated the work and nearly ten groups completed the task. The groups which were unable to complete were merged with the groups which had completed their task and so could help them to finish their pending work.

After that, groups of four students each were made and each group measured the dimension of classrooms, verandas, open space, pavements,

connecting roads etc. The scale was negotiated, finally assuming that 1 ft = 1 cm.

After the area was measured, a discussion on calculating area and perimeter based on textbook content followed. Students calculated the area and perimeter of the classrooms they had measured. Based on the dimensions recorded, students made a scaled model of the classroom building, including the windows and doors of the room, as well as veranda and garden area.

During the entire process, students worked in groups outside the classroom, helping and motivating each other and giving contextual answers to the questions in the textbook. The result was that when the model was completed, the students were very happy.

In this experiment, students learned how to make sketches, measure the area and perimeter of rectangular surfaces, creating 2D and 3D shapes, helping each other and presenting their work to a larger group and an external audience.

To facilitate the process, there had to be several steps in classroom management. For example: grouping the students to ensure mixed ability groups, dynamic classroom structuring including sitting arrangements, scheduling of class time and changing the timetable as required and extending the duration of the period from forty five minutes to five hours. It also meant that teachers and students had to arrange the required materials.

Initially, it was difficult for the students to comprehend the idea of making sketches with the right orientation and direction and then modelling the classrooms which had more than four sides with walls that were not at right angles to each other. It was difficult for the teacher to engage students who had finished their work earlier than the others. On the other hand, some of the students took longer than the given time.

The project was mainly conceptualised and carried out by the second author of this article. However, other colleagues also helped in the process. At the later stage, one of the groups was guided by another colleague.

### Water audit

For grade 7, we chose the theme of water as it was included in the geography and science NCERT textbooks. The teaching unit was planned to

integrate chapters from mathematics - fractions, area, perimeter, volume, percentage, graph plotting and cross-section of solid objects - while carrying out the project. The project included elements from both inside and outside the classroom.

Discussion in the classroom started with the use of water in our lives and listing areas of use. Students surveyed the newspaper and listed out water related issues. Then they recorded the use of water in school and measured the amount of water utilised in each category.

Now, eight groups of three members each were formed and each of the groups was asked to measure water use under six heads. Table 1 shows the amount of water calculated by students under each head.

Group number	Area of water usage	Amount of water used in litres per day
Group 1	Mid-day meal	115
Group 2	Watering of plants	1192
Group 3	Drinking water	70
Group 4	Water used in the toilet	776
Group 5	School cleaning	304
Group 6, 7, 8	Usage in other areas	5

Table 1

In the following sections we will give brief accounts of strategies followed by students in calculating water consumption and usage.

*(Water was measured and calculated with a one litre mug).*

### Midday meal

Students went to the kitchen and recorded different areas of water usage in cooking the mid-day meal and measured the water usage in the following areas:

washing *dal* (4 l), rice (7 l), and vegetables (6 l)

boiling the *dal* and vegetables (13 l) and rice (25 l)

washing utensils (60 l)

washing plates (550 l)

To calculate water consumption for washing plates, the group selected four students of each class and asked them to wash the plates in the same basin. Then they calculated the volume of the water collected in the basin to arrive at the total water consumption by 140 members.

#### *Watering the plants*

Students surveyed the amount of time required to water the plants and rate of water coming out of the pipe. A bucket of 15 litres filled up in two minutes. So the result was 1192 litres of water were being used for watering the plants.

#### *Drinking water*

The group took a 15 litre watercan with four students of each class asked to drink the water from that can only. The frequency of drinking was also noted with the members recording the data at the site for three consecutive days. It was found that thirty two students consumed sixteen litres of water. For 140 members, the water required is about seventy litres.

#### *Water usage in toilets*

For this, students measured the water capacity of the tank, filled the tank with water and measured the water let out with each use. This amounted to 676 litres used in the toilet for flushing and washing. Students discussed with the support staff responsible for taking care of the toilet space and found that 70 litres are used for washing the floor and 30 litres are used for washing basins.

#### *Usage in cleaning the school*

Here students worked with the staff responsible for the cleaning of the school. They also took part in the cleaning to have a better idea of water usage and found that total water used was 304 litres. This included cleaning of entrance (30 l), cleaning of drain (60 l), washing bedsheet (32 l), towels (12 l), MDM hall (150 l) and basin area (20 l).

#### *Usage in other areas*

Students explored the different areas of water use. To do this they asked teachers, support and administrative staff for details of the amount of

water used to carry out science experiments (0.06 l), art and craft sessions (0.03 l), making tea (3 l), cleaning of waste bin (1.8 l). The total consumption came to about 5 litres.

Students collected all the data, made a graphical representation of water usage, compared the water usage in different areas and had a classroom discussion. To do this, students worked in groups, discussed and designed and devised ways to collect and measure data, collect and got an idea of water use in different areas.

In this project students also carried out an investigation into the properties of water and made a model of the water cycle. Reading and writing were an indispensable part in the project. Students could relate to the real-world context while understanding the content of the textbook and the relevance of knowing mathematical concept like measurement of volume, finding out percentage, and plotting graph etc.

Unlike the grade 5 project, we often used three hours or more each day for conducting the project. There were at least two teachers (the third and fourth authors of this article) always with the students. Often, three teachers and one or more teacher educators supported the teachers and students.

The project was very intensive in many ways. It involved three or more teachers at a time with twenty five students and much time was invested in it. The teachers in charge of the project found it very challenging to guide the students. Seemingly easy questions, like amount of water used in the toilet every day, were found to be difficult to calculate or measure.

#### **The way forward**

It was the first time that a project of this nature, involving the whole school, was attempted. The teachers in charge found it a great learning experience, though it was energy intensive and time-consuming. However, to manage such a large project requires a great degree of planning and school support. We plan to make it a project-based learning unit on the same topic along with appropriate assessment tools.

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