

**Developing a lesson plan
for the topic of
“sustainability and design”
for class 10 CBSE students**

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Introduction

In recent times, most of us, including academicians, industrialists and even common people have come to realize the importance of the design thinking process, and how it can help solve problems in different areas efficiently. Teaching design and design thinking at a young age are important to ensure more awareness, for students, the future working adults of the country, to realize its importance and relevance in the creation of various products, services, governing systems and so on. Many efforts have been taken by the Indian government to introduce design education in our country. Design is currently being taught in many national and private colleges and universities. When it comes to school education, some education boards offer art and crafts as an optional subject, and also have a few design electives for senior students. Apart from that, there is no compulsory design or design thinking education taking place at the school level.

The CBSE board is very popular in India as it has a robust curriculum and also trains students for the various other competitive and entrance exams within the country like IIT-JEE and so on. Although the CBSE curriculum has been designed with a lot of thought, students still struggle to apply all their acquired knowledge in their daily lives. Design and design thinking is being introduced by CBSE in its curriculum as a new skill education elective, for class 6th to class 11th (as part of National education Policy 2020). 650 hours have been allotted for learning this subject. An

existing design thinking curriculum development team (hereon referred to as the “**DT team**”) is working on designing the curriculum and they have set up a basic framework, and chosen different modules for each class. This project focuses on one single module, in the set of modules meant for class 10 students, named “**Sustainability and design**”.

There have been many other studies indicating that teaching design thinking to children can empower students, and raise interest in personal and social creativity and innovation too. (Grammenos, 2018). John Spencer, the author of the book “Launch: Using Design Thinking to Boost Creativity and Bring Out the Maker in All Students” explains that “when students define themselves as makers and inventors and creators, they discover powerful skills—problem-solving, critical thinking, and imagination—that will help them shape the world’s future” (Spencer, 2016).

Aim

The aim of this project is to create a lesson plan and other learning materials for the “sustainability in design” module, part of the design thinking skill education elective, meant for class 10 CBSE students studying in India. Instructional design theories and topic-specific content are studied, and materials such as the lesson plan, and information manual are developed. The materials developed in the end are

evaluated by class 10 teachers, and their feedback is collated and problem areas are identified in the project.

Target audience

The target audience is the class 10 CBSE students and teachers in India, which is an extremely diverse group.

Deliverables

For this project, a lesson plan, supplementary information manual, and task books for students are designed for the module. The lesson plan and information manual are to be used by teachers, while task books are to be used by students.

Scope

Although the project is scoped down further in the upcoming sections of the project, some of the initial assumptions are:

- Students have studied all the modules in the design thinking elective leading up to the one being designed in this project and have completed their social studies lessons leading up to class 10.
- Students and teachers are from diverse backgrounds
- Teachers are willing to conduct activities and discussions and engage with the students.

More points are added to the scope as the report proceeds.

Secondary research

Choosing instructional design process

The next step was to decide on the instructional design process. Many models were explored, some of which were the ADDIE, ASIE and ASSURE models.

The ADDIE model has been widely accepted among educators and instructional designers and is the most commonly used model. "ADDIE" stands for **Analyze, Design, Develop, Implement, and Evaluate**. It is an iterative process with revisions to be conducted at each step. It is based on the five-step approach developed for the U.S Air force. It retains the hierarchical structure but makes it an iterative process. (Kurt, 2018)

The ASIE model is an online planning ID Model which serves as an alternative to the existing traditional ID models which support experiential and collaborative learning for learners in gaining and re-producing information. ASIE stands for **Analyze, Strategize, Implement and Evaluate**. It is interactive to the user, integrative in planning the content, prescriptive in the planning procedures and constructive in the organization of the components. ASIE Model can be considered as an adaptation of the various ID models particularly ADDIE and ASSURE (Zain, 2016)

The ASSURE, developed by Heinich Molena, Russell and Smaldino in 1999 is based on R.M. Gagne's theory of Instruction. (Bajracharya, 2019). The five-step design process involves the steps of **Front end analysis, learning objectives/outcomes, task analysis, strategies and evaluation**. It is flexible and can be used to create different types of instruction.

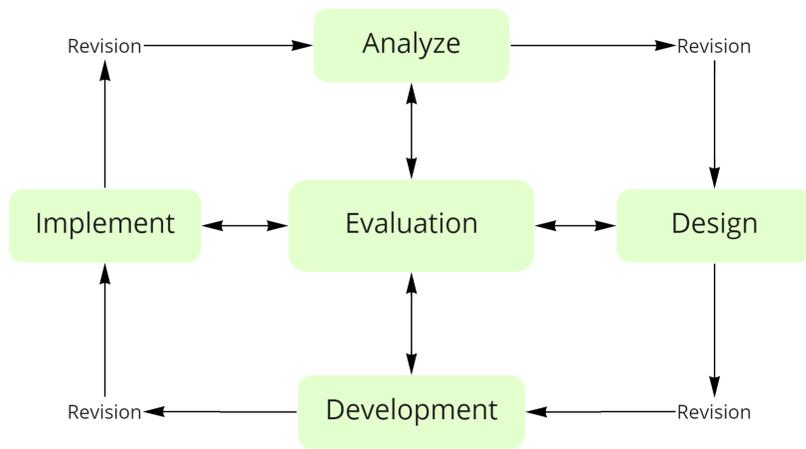


Fig. 1 ADDIE model

The **ADDIE model** is chosen for this project as it is a well defined and iterative model, and there is a large amount of documentation on how to use it. For this project, the “Implement” stage in the ADDIE process is not applicable, as it involves the redesign, updation, and editing of the developed materials, which is not feasible within the duration of this project.

Analysis

Understanding the learners

An initial internet search and conversations with teachers in CBSE led to the following findings.

Demographics

- According to the 2020 press note on the CBSE examination statistics found on the CBSE website, there were over twenty thousand CBSE schools in total all over India, at least those that participated in board examinations for the 10th class.
- There are over 18 lakh students who registered for the 10th class board exams in India.
- These students have very diverse backgrounds and come from both rural and urban settings.
- The CBSE board provides the provision of teaching and learning in both Hindi and English.
- One can not assume all CBSE students have access to the internet, smartphones or any other learning devices.

Prior knowledge and awareness

During a previous [project](#), a few semi-structured interviews were conducted with school children of 12-15 from Mumbai and Chennai, to assess the prior knowledge that they had

regarding sustainability, and the following insights were found:

- Students already have a considerable amount of knowledge about sustainability, resource conservation. They have a broad idea of what it means to live “sustainably”.
- They were aware of sustainable practices one can follow as a common citizen.
- Places, where they hear about sustainability, are mostly schools, and sometimes social media, television environmental enthusiasts and events like nature walks or awareness campaigns.
- They think the older generation of people does follow eco-friendly practices, reusing old things.
- They do feel the need to be conscious of our actions, and they give examples such as using less plastic, and conserving electricity.
- Students studying at CBSE are exposed to similar topics in other social science lessons, as found in the interviews.
- Those kinds of lessons are generally taught towards the end of the academic year and are not usually covered in detail.

These insights are quite helpful since they show us that these children already have certain ideas about how to be sustainable but since this study was limited to only a few participants from metro cities, we have to assume that the actual target audience may not be as well aware of the terminologies and jargon.

On further investigation, it was found that class 10 students have a chapter in their Science textbook titled “Sustainable management of resources” which does a good job of introducing students to various environmental sustainability issues and highlights the role of traditional systems, practised by locals, in maintaining the environment.

Adding to the scope - What we can do differently is help them view the topic of sustainability as future designers, engineers and creators of the world. Making them aware of the power they hold in every decision they make when they design products, and create built environments and legislation for them can be helpful.

Understanding the expected module structure

The DT team from CBSE has already specified a set of modules for each class and allocated 160 hours of design thinking classes for class 10th students. Within the duration of 160 hours, there are some modules having a duration of 12, 18 or 32 hours. The module chosen for this project is “sustainability and design” and has been allocated 18 hours.

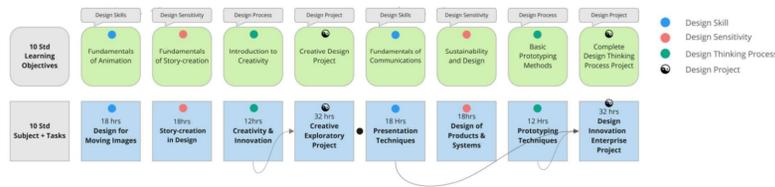


Fig. 2 Design thinking curriculum for class 10 (source: CBSE, tentative)

The 18 hours is inclusive of **12 hours in class** and **8 hours at home**. This subject will be taught weekly once in a 2-hour session, as per the existing plans. On enquiring with some CBSE schools, it was found that the average duration of one class is around 45 minutes which implies that 2 or 3 classes will be grouped together to have the 2-hour session.

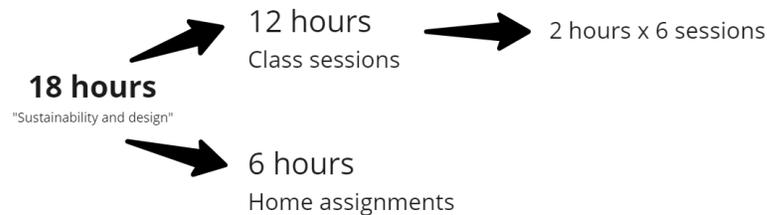


Fig. 3 Class and session duration

Understanding and assembling content

Deciding the content took up a considerable amount of time in this project, as it involved a couple of iterations and discussions with domain experts. The process of assembling content involved

- Understanding the requirements of what to teach from the DT team
- Literature review about sustainable design, papers, articles, and book chapters.
- Understanding what other schools, education boards and curriculums teach their students relevant to the topic in focus.
- Looking at MOOCs that taught sustainable design, like the [NPTEL course](#) on “Strategies for Sustainable Design”
- Talking to domain experts and teachers regarding what kind of knowledge and skills qualifies a person as “able to design sustainably”

Iteration 1

The first set of topics were assembled before consulting the domain experts and they are listed below:

1. What is sustainability? What is sustainable design?

2. Sustainability inspired by culture, nature:
3. How to design sustainably? - sustainable design strategies:
4. Consequences of good and bad design - case studies
5. Why should we care? - Current Societal and environmental and the climate crisis

The above-mentioned titles were initially elaborated much more but that content has been removed as it is no longer relevant.

Analysis phase evaluation

This initial list was presented during the first of the three jury sessions, and the panel pointed out many issues with the set of topics:

- Curating the content for a lesson needs competence in that particular field
- The content curated has imported western notions, is available everywhere and will not make any difference if it is not adapted to the Indian context.
- How will students of different backgrounds respond to the content?

I then proceeded to meet a couple of domain experts who were found through the internet and mutual acquaintances.

Discussion with Dr Radha Gopalan [Radha Gopalan - Azim Premji University](#)

Dr Radha Gopalan is a visiting faculty at the Azim Premji University School of Development. She trained as an environmental scientist and did her PhD in Environmental Science and Engineering at IIT Bombay. She has been developing resources to make natural history and science learning more practical and meaningful for school students. A discussion with her was held, and a brief introduction about the project and the existing list of topics were shown to her. Her feedback is summarized as follows:

- Unlike "sustainable development" goals, which have an end when they are met, sustainability is a constantly evolving journey.
- There are many frameworks used to think about sustainability, and multiple perspectives to view sustainability - as economists, chemists, biologists and so on.
- When designing the lesson plan, I should choose the perspective I want to offer - as a designer? Or as a legislation maker? Healthcare worker? What is the perspective? Generalizing will not help.
- People don't only make design decisions - they make choices and do actions. We need to account for those.

- What I have done is quite conventional, splitting into topics for each session with heavy words and jargon.
- For example - when I say industrialization - we have too many aspects we have to learn - and these words may scare students away.
- Instead of topics - decide what ideas students should leave the course with. Topics are restrictive
- Only 4 or 5 ideas must be picked, there are too many topics in the list and it might overwhelm students
- Introducing students to how things are made, meaning the product lifecycle, in a way that is easy for them to understand was also recommended
- Students could try to redesign something based on what they learn instead of doing unrelated class activities.

Discussion with Mr Ramasubramanian Oruganti

[Rama subramanian – Welcome to the Sustainable Livelihood Institute \(tnavsli.in\)](http://Rama.subramanian-Welcome-to-the-Sustainable-Livelihood-Institute(tnavsli.in))

Mr Ramasubramanian Oruganti is the director and co-founder of the Sustainable livelihood Institute, which is a joint venture between the Government of Tamil Nadu and the Auroville Foundation. He is an active advocate for safe food and sustainable society. A discussion with him was held, and a brief introduction about the project and a list of topics were documented and emailed to him. His feedback is as follows:

- The flow and the structuring of the sessions are good. Rooting it in the local is where it gains higher impact.
- Provide them with some ideas beyond the personal level on sustainability – for instance, the concepts of a community that lives and works together.
- Language and how local languages are often a repository of sustainable knowledge from tradition – with practices, this could easily be an exercise
- Observations around food are the easiest way to teach sustainability. Calculating food miles for a birthday cake is a good example.

Both the discussions were very insightful and helped make changes to the content structure, and order and make it more relatable for students and easier to teach for teachers of the specific target group.

Iteration 2

The changes made based on all the feedback have been elaborated in the following section.

- Lesson plan scoped down and designed with the **perspective of someone who is involved in the creation of products.** - The previous set of content tried to cover too many perspectives such as services, legislature, engineering, and design. A decision was

made to focus only on the designer’s perspective, and on how physical products are created.

- **Reduction of content** - The common feedback was that too much was being taught in such a short amount of time, and therefore it was reduced to 4 main ideas
- **Framing concepts/titles as questions and ideas** instead of just topics - Understanding the lesson as a set of ideas that the student can leave with can help figure out what exactly has to be taught instead of lingering around difficult words and concepts.
- **Staying away from purely western notions** - Many of the concepts from the west are present in Indian context too, so instead of explaining with new words, explaining it with examples from what students are familiar with was done.
- **Removal of jargon** - Heavy words were removed as suggested, and were replaced with simpler sentences and questions to encourage thinking.

The following diagram displays the arrangement of content and how it has been sectioned into sessions. The main heading/idea has concepts/topics and subtopics (color scheme corresponds to diagram). This content will be fully elaborated in the [information manual](#), which will be covered in the upcoming sections of this report.

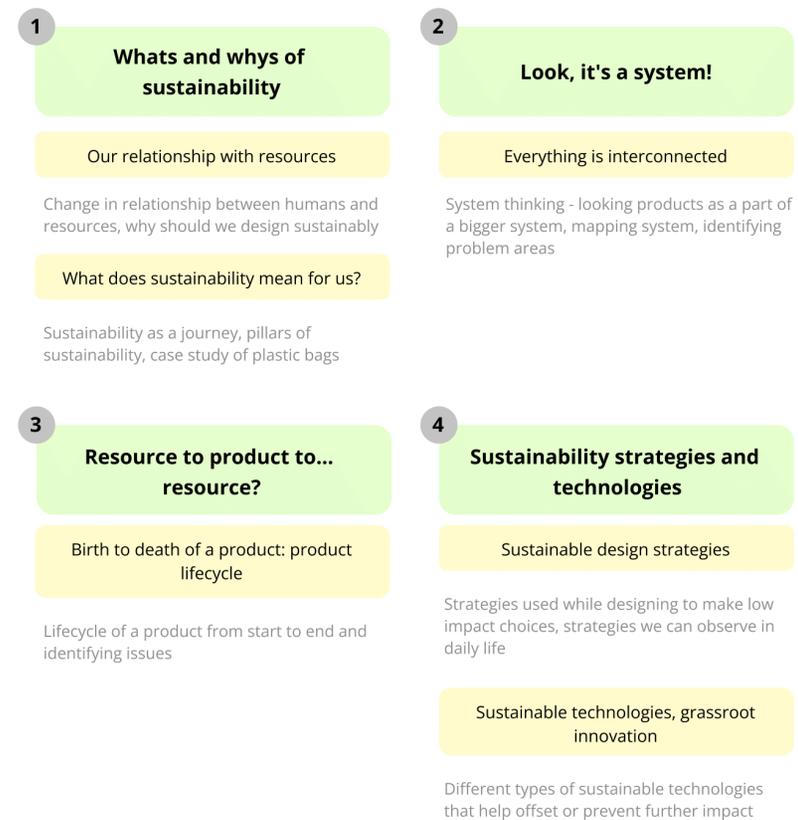


Fig. 4 List of curated topics

References to the sources have been made at the end of the [information manual](#).

Design

The next step in the process was to design the learning materials. The final list of deliverables is as follows:

- **Lesson plan** that contains learning objectives, Activities, and session-wise plans
- **Information manual** that contains the supplementary content and material needed to conduct activities.
- **Exposure presentations** - It was decided by the DT team to use presentation slides as the method of presenting the subject content to students.
- **Task book** to be used by the students

Each of the elements was developed first individually and compiled into the

Distributing topics to sessions

The set of 4 topics is to be split across 6 sessions. Taking into consideration the advice to have a longer more conclusive activity and a final presentation, the last two sessions were excluded for that purpose. Therefore each topic is covered in one session, which may include smaller activities, discussions and a part of a longer redesign activity. The diagram below represents the distribution of the topics among sessions.



Fig. 5 Topics covered in each session

Learning objectives

To frame the learning objectives, the **ABCD format** was chosen, as this subject isn't purely skill-based, but also tries to achieve a shift in attitude.

Primary learning objectives

By the end of the module, students must be able to

- **Summarize** why we need to change the way we use resources and design the things we use.
- **Explain** the various aspects of sustainability and how a balance of all three is required to achieve sustainability, with an example.
- **Visually depict** the ecosystem in which a product exists, and map out all the entities and stakeholders involved.

- **Think holistically**, suggest changes to existing ecosystems and judge the potential consequences of each decision.
- **Map out** the lifecycle of a product, identify issues in the different phases and **suggest** alternative methods to resolve them.
- **Apply** sustainable design strategies during different phases of the design process of their product or service.
- **Redesign** a product using the learnings from this module and present their redesign concisely and creatively.

Desired attitude shift

By the end of the module, students should be

- able to realize their role in shaping society as future creators.
- Motivated to move towards more sustainable ways of creating products and solutions
- Understand the impact of even the smallest design decisions on how people use a product or service, and in turn, its effect on society

- Understand the impact of unsustainable products and services on the planet and the urgency with which we need to deal with it.

Session specific learning objectives

There are five sets of session-specific learning objectives corresponding to each session. The complete list is mentioned in [appendix A](#). There are around four learning objectives per session. The teacher can evaluate whether the objectives are achieved by questioning them and observing their understanding, no specific assessment will be done.

Design of activities

Important learning theories

The three main learning theories of behaviourism, cognitivism and constructionism were explored. Behaviourism works very well in situations where reinforcement and repetition are necessary to master a certain skill, like physical activities, but is not so effective in other educational areas like learning concepts and their application. Cognitivism believes that knowledge resides in complex memory structures in the human mind called schemata, and learning is the process of changing these structures. The constructionist theory assumes that learners already have prior knowledge and mental models and that a learner can construct their own knowledge. It also

emphasizes the learner's active engagement in what they are learning for the most effective learning experience.

Seymour Papert says that "The kind of knowledge children most need is the knowledge that will help them get more knowledge" in the seventh chapter of his book "The children's machine" (Papert, 1993). This is very relevant in today's world, where information is readily available and the most important process of learning, not just academic learning, is to know what to learn. Learning through the constructionist method involves students conducting their own experiments and making their own inferences, they learn by doing. The teacher is a mediator rather than an instructor.

With these key points in mind, it was decided that the constructionism theories could be used to design the activities for this module since this is a subject that aims to bring about a certain attitude shift in the minds of the learners, as well as learning skills and knowing how to apply them. Since the students have been exposed to the concepts of sustainability already by the time they reach this module, one can help them build knowledge on top of the existing concepts in their minds.

The importance of designing for the learner's specific context is also emphasized in many studies. Papert says in the eighth chapter of his book Mindstorms - "Thus we are

brought back to see the necessity for the educator to be an anthropologist. Educational innovators must be aware that in order to be successful they must be sensitive to what is happening in the surrounding culture and use dynamic cultural trends as a medium to carry their educational interventions.”

To summarize the important points that need to be kept in mind while designing the activities for this module are:

- Building on existing knowledge of the concepts
- Active engagement of students in what they are learning
- Learning how to learn beyond the classroom
- Learning by doing
- Designing relatable activities for the students’ context
- The teacher assumes the passive role, helps children in the discovery of knowledge

Kolb’s experiential learning theory

David Kolb, who introduced the experiential learning theory (ELT), states that learning involves the acquisition of abstract concepts that can be applied flexibly in a range of situations. (Kolb, 1984). The ELT contains a four-stage cycle of learning and four separate learning styles. Effective learning is seen

when a learner progresses through a cycle of four stages. Firstly the learner has a **concrete experience**, which could be a new experience or situation, or a reinterpretation of an existing experience in the light of new concepts. The learner then **observes and reflects** on that experience leading to them forming **abstract concepts** or modification of existing concepts. The learner finally applies what they understood, and conducts **experiments**, resulting in new experiences.

In an article titled “Using Kolb’s Learning Cycle to Improve Student Sustainability Knowledge”, the authors tested a learning-cycle based course on sustainability for a batch of cornerstone design course students within a civil engineering program. These students showed improvement in knowledge connectedness compared to the other students who learnt this in the conventional methods (Watson, 2019).

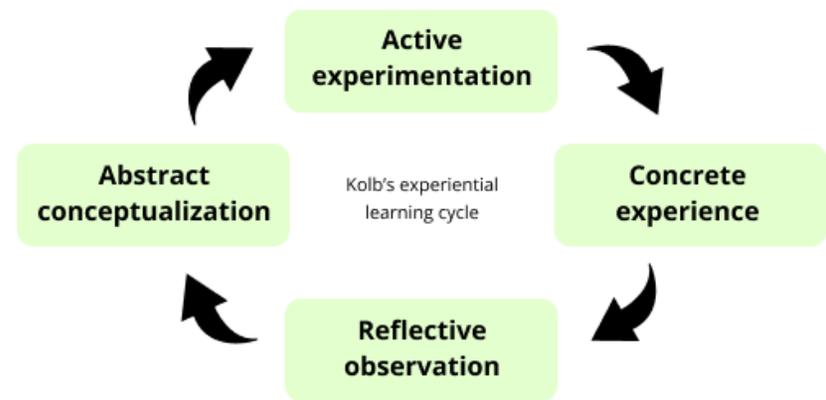


Fig. 6 Kolb's learning cycle

Using stories

The idea of using stories with activities was explored due to two reasons. Firstly, it is a well-known fact that the use of story-telling is an effective way to help children understand abstract concepts. In an article that talks about “Developing science concepts through story-telling” (Banister, 2001) the authors concluded that based on their post-tests, the retention level of the water-cycle concept told using stories was much higher, than any other science concept they had learnt that year.

The second reason is that CBSE has done something similar to this in their class 9 economics textbook. The first lesson titled “The story of village Palampur” introduces the basic concepts related to production and this is done through a hypothetical village called **Palampur**. The lesson gave a clear picture of the village and the activities that went on there and helped children understand the otherwise boring concepts. Palampur is something CBSE students do not seem to forget, even after passing out of school, based on a few discussions with people who studied in CBSE schools.

The topic of sustainability can definitely be heavy and drab, so a story could be an interesting way to hold attention and also tie all the concepts together. There were two kinds of story ideas that came out during ideation:

- A story about a girl from the city visiting her native village and making a new friend. The duo goes around the village and exchanges what knowledge they have about sustainability with each other. Villages are generally known to coexist with nature and learning the concepts mentioned above in the context of a village (Just like Palampur) could help students from all kinds of backgrounds relate to the content better.
- The story of a grandmother-granddaughter duo starting a pickle business together in a small town. Students can learn the concepts mentioned above by analyzing what goes into starting and maintaining the pickle business. As mentioned by Mr Ramasubramanian after going through my initial list of topics, **food is a great way to explain system thinking and sustainability**. Understanding what part of the food comes from where, what it takes to transport the ingredients, manufacture it and ship it.

When comparing both stories, the first idea could be more relatable to students, but not as successful in conveying the abstract concepts. The second idea seems to do a better job at tying the concepts together. Therefore the second story was taken forward.

Interchangeability of activity elements

The designed activities have parts of them that can be modified by teachers who feel the need for more contextual examples since the target audience is an extremely diverse group. Examples and stories which students can relate to can really enhance the learning experience and understanding of the students. Teachers will have to customize some parts of the activity and will be guided on doing so in the information sheet.

Designing the activities

Based on the above research, the activities for each main idea were designed. Some activities provide a concrete experience for the students, after which students can reflect and learn. Some activities begin with the recollection of old concepts, while others begin with stories. There are three types of activities in this lesson:

- **Class activities** - These are done during class hours, either individually or as a group. They will be based on the story discussed above. The teacher does not “conduct” the activities, but facilitates them, while students take up the dominant role. Eventually, the teacher helps students to understand the idea in the end.
- **Long group activity** - This was introduced based on the suggestion by Dr Radha Gopalan when she went through the initial list of topics. This activity ties

together the main ideas learnt by the students and they have something solid to show at the end of their 12 hours of learning and creating. They will initially choose an object to redesign, apply what they learn in each session to redesign that particular object and finally present it to the class.

- **Home activities** - These are kept simple and group activities at home are avoided. In fact, students get almost half of their class hours to work on their group activities so that they do not have to worry about collaboration at home.

The reason home activities were kept individual is that, during the semi-structured interviews done in the beginning, students found it difficult to collaborate at home due to the varying conditions, backgrounds and availability of resources to do the same. Students are already burdened with many other subjects, and collaborating and working with other students may turn into a hassle, and might affect learning.

The next step was to try and use Kolb's learning cycle in designing each of the sessions. After some brainstorming, the following process was framed:

- Students initially listen to stories/do skits and experience a concept in action during class activities **(Experience)**

- Then, a discussion between the students and teacher occurs, where the teacher tries to help the students express what they observed (**Observation**)
- This is followed by the teacher using the exposure presentations to help students understand the concept thoroughly (**abstract conceptualization**)
- Finally, the concepts they learn are applied in their long group activity sessions and home activities. (**experimentation**)

This cycle is represented in the following diagram:

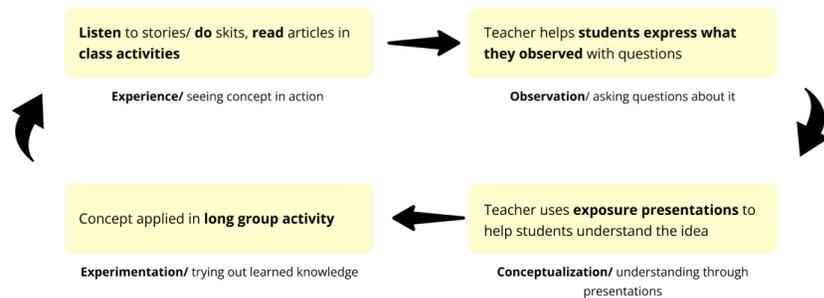


Fig. 7 Applying kolb's learning cycle to the sessions

Detailing out long activity

Students will be given time during class hours to discuss with their teammates about the long activity. If possible, access to resources such as internet connection, relevant books and articles can be provided to the students during

their discussion time. The teacher can move from one group to another to discuss their doubts during this time.

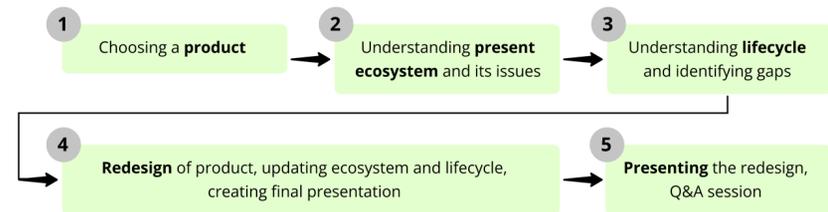


Fig. 8 Parts of long activity in each session

Time allotment for each session

Before proceeding to design and detail the activities, time had to be allocated to the various things that would happen during a session, like class activities, discussions, exposure presentations and long activity discussions. After trying multiple combinations, the following split up was finalized. This includes

- Time for class activities + post-activity discussions or discussions
- Exposure presentations
- Time for long activity discussions, and final presentation (more time has been allocated to these sections to account for any delays, prolonged discussions and so on).

Teachers can go ahead and adjust the timings as they wish.

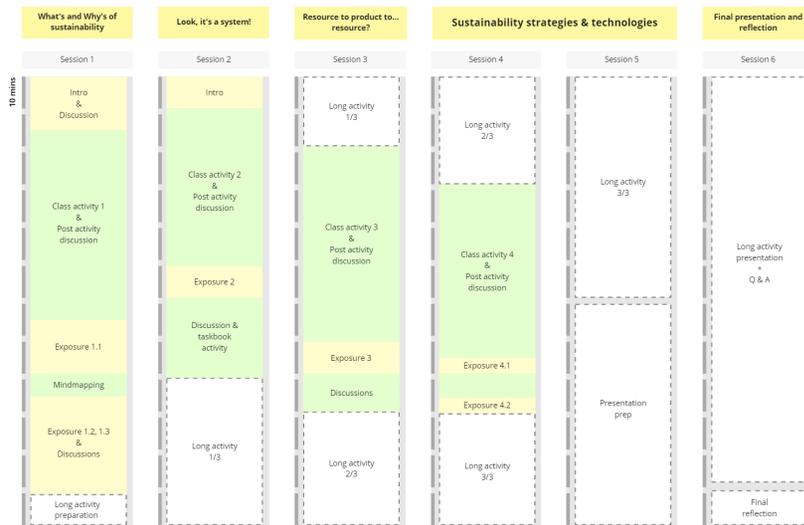


Fig. 9 Suggested time allotment for sessions

Design of class and home activities

This part of the project was a very iterative one, as many teachers and students were consulted and multiple activities were created before some were finalized and developed in detail. The initial ideation is available at this [link](#).

Class Activity 1 - Getting my lunch

In this activity, the students have to assume they are in a different time period in Indian history and depict through a skit how they got their lunch, collect resources, and how they handle leftover food. As they act the skit, they understand things and behaviours that change as human society progressed and this drives home the point that as society progressed and their impact on their surroundings increases.

Interchangeability - Although a template is given, the teacher is allowed to choose 4 time periods, which could be more relevant to students from different contexts, information about which can be collected by them and given to students to help them with their skits.

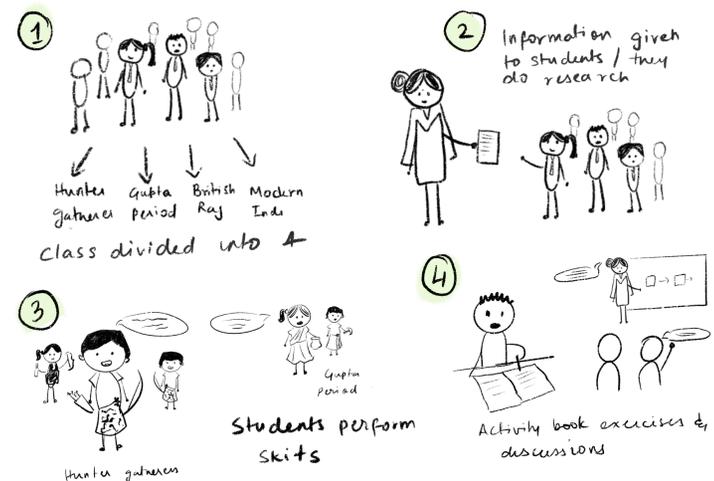


Fig. 10 Class Activity 1 - Getting my lunch - storyboard

Class Activity 2 - Mrs Preetha Prakash & her pickles

This activity involves listening to the story of Mrs Preetha Prakash and her pickle business. On listening to the story, the students will have to create an ecosystem of Mrs Prakash's town, its elements in it and its stakeholders. The main product here is the jar of pickles. Students will listen to the story and then visually represent the town, and how different elements interact when Mrs Preetha makes her pickles. They will pair up and continue to make their maps more detailed

Interchangeability - Parts of the story that can be switched out for any other food product have been highlighted, as pickles may not be familiar to everyone in the target group.



Fig. 11 Class Activity 2 - Mrs Preetha & her pickles - storyboard

Class Activity 3 - How are Mrs Prakash's pickles made?

Students assume the role of the different parts of the lifecycle of the pickle, and they enact the process of turning the resource into the final product, distributing and disposing of it. As they do this, others note down each step on the board, and the teacher in the end describes each phase of the lifecycle from what they have written. Acting the stages out would be a fun and engaging way of understanding the process.

Interchangeability - If any other food product was used in the previous story, the teacher must define a lifecycle for it, and keep it as a reference.

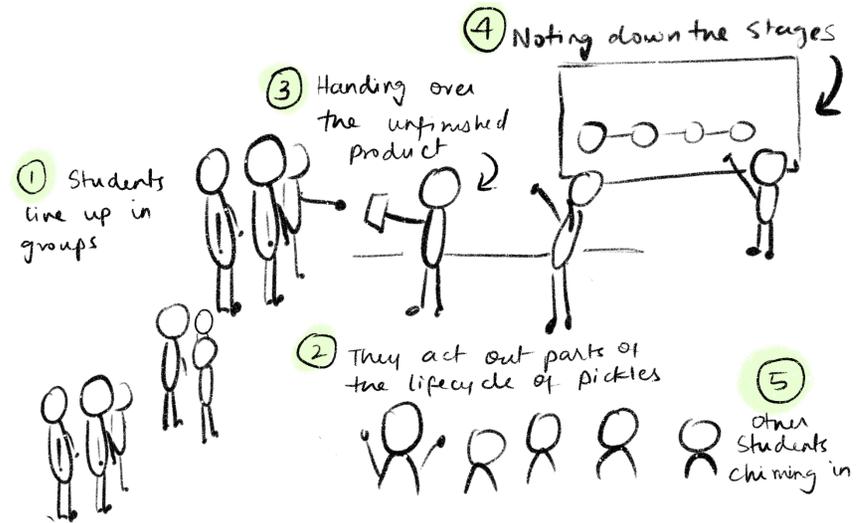


Fig. 12 Class Activity 1 - Getting my lunch - storyboard

Class Activity 4 - Strategy charades

Students use charades to help their teammates guess the different sustainability strategies, with the help of their own findings from their previous exercises as clues, and the team with most points wins. The aim is to get students to find their own ways to explain sustainability strategies to the rest of the class, driving home the meaning and how it can be applied to products. They will use their own findings and collective experiences to convey the strategies to their classmates.

Interchangeability - The teacher can use any kind of example to explain each sustainability strategy to the students when the initial demonstration of how to play is done.

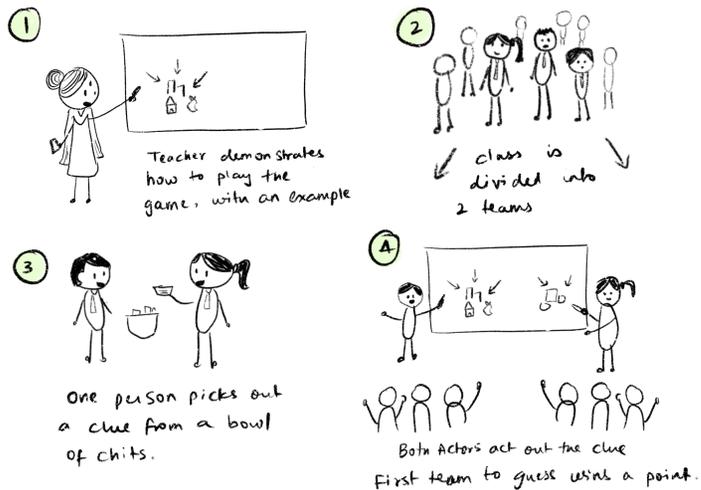


Fig. 13 Class Activity 1 - Getting my lunch - storyboard

The other activities have been detailed added to the lesson plan ([google docs](#) and [final layout](#)), which will be discussed later.

Sessions	Session 1	Session 2	Session 3	Session 4	Session 5	Session 6
What's and Why's of sustainability	Look, it's a system!	Resource to product to... resource?	Sustainability strategies & technologies	Final presentation		
Main Topics	How did we use resources? How our usage change? What does the term sustainability really mean for us??	Everything is interconnected!	Returning borrowed resources - Lifecycle of a product	Sustainable design strategies from our daily lives Sustainable technologies	Allocated for presentation preparation	Allocated for presentation and reflection
Activity	Getting my breakfast Understanding change in how we use resources and its impact - through an impromptu skit of how people from different time periods got their lunch	Mrs. Preetha & the pickles Listening to story of Mrs. Preetha, her town and how she makes her pickles - System thinking - Writing/drawing the ecosystem of Mrs. Preetha's pickles.	How are Mrs. Preetha's pickles made? Lifecycle thinking - understand how Mrs. Preetha's pickles can be made - impromptu skit of every phase of lifecycle of making those pickles.	Sustainability charades Understanding sustainability strategies through a game of charades played by class, split into teams.	Allocated for presentation preparation	Allocated for presentation and reflection
Long activity	Long activity preparation	Ecosystem of product & issues	Lifecycle of product, gaps	Product redesign	Final presentation preparation	Presentation and rapid fire Q&A
Home activity	Before and after Understand how the introduction of one product can bring about so much change by comparing how the world was before and after, in all pillars of sustainability	Vasudhaiva Kutumbakam Help students understand the presence of interconnected systems in life by mapping out a natural system that they can see outside their window	Linear vs circular Students explore the lifecycle of a product further, specifically about the linear and circular lifecycles/ economy. They are to answer questions and provide examples.	Sustainable technologies Students will pick an instance where technology has helped solve a sustainability issue and answer questions on whether it was necessary and if it caused other effects	Vasudhaiva Kutumbakam Students will understand the concept of grassroots innovation, by reading an article, and visiting the grassroots innovation website of the Indian government	Individual reflection and feedback Students answer a set of questions which helps understand whether this module has brought on any change in the attitudes of students. It can help develop the module further.

Fig. 14 List of activities corresponding to main ideas ([link to pdf](#))

Assessment criteria

It has been decided by the CBSE team that exams will not be conducted for any of the design and design thinking modules. Every topic will have an assessment rubric, which will translate to grades. Once the activities are finalized, the assessment rubrics will be created.

Grade Awarded	Grade	Points
Outstanding	O!	10 (or Extra Points)
Above Excellent	AA	1.0
Excellent	AB	0.9
Above Proficient	BB	0.8
Proficient	BC	0.7
Above Promising	CC	0.6
Promising	CD	0.5
Above Developing	DD	0.4
Developing	DE	0.3
Above Beginning	EE	0.2
Beginning	EF	0.1

Fig. 15 Final grading for modules

Beginning FF-EF-EE 0.0-0.1-0.2	Developing DE-DD 0.3-0.4	Promising CD-CC 0.5-0.6	Proficient BC-BB 0.7-0.8	Excellent AB-AA 0.9-1.0
Criteria 1	Criteria 1	Criteria 1	Criteria 1	Criteria 1
...	Criteria 2	Criteria 2	Criteria 2	Criteria 2
...	...	Criteria 3	Criteria 3	Criteria 3
...
...

Fig. 16 Grading method with rubrics for activities

A similar approach was used for this project. The topic-wise assessment would happen first, which would include grading all the activities that fall under one topic. The grade for each session would be the average of all the topic grades in that session. Finally, the overall grade would be the average grade of all sessions. The diagram shown below explains it better.

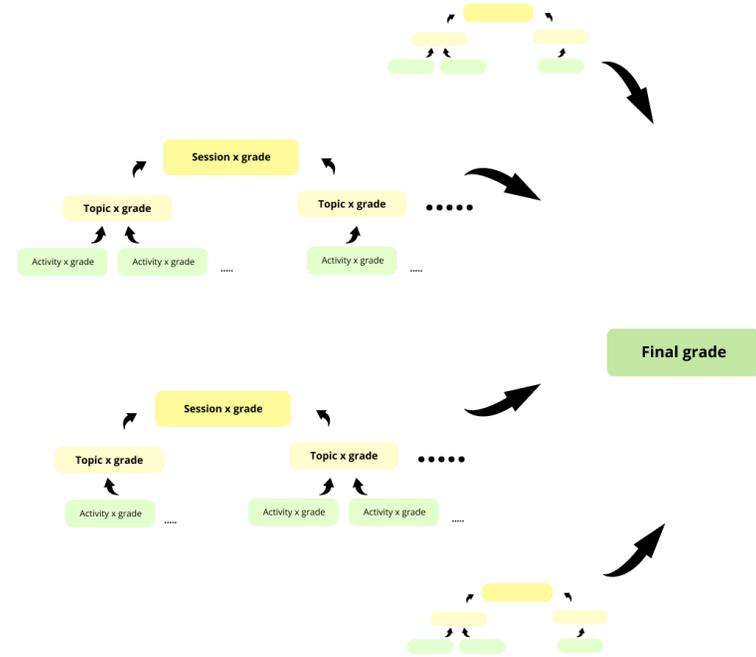


Fig. 17 Final grade calculation

The following is a sample rubric for one of the activities.

Topic1: Criteria for Activity x:

- Criteria 1
- Criteria 2 ...

	Beginning 1 - 2	Developing 3 - 4	Promising 5 - 6	Proficient 7 - 8	Excellent 9 - 10
	Only C1 was satisfied	C1 and C2 were satisfied	C1 and C2 were satisfied and C3 was partially satisfied	C1, C2 and C3 were satisfied	C1, C2, C3 and C4 were satisfied
C1	Green	Green	Green	Green	Green
C2	Grey	Green	Green	Green	Green
C3	Grey	Grey	Green	Green	Green
C4	Grey	Grey	Grey	Grey	Green

Fig. 18 Rubrics for activities

A similar assessment approach is taken for the long activity too, where there are more criterias present, and is done in the last session after presentation.

Feedback from jury 2

The designed elements were presented to the jury, and the feedback received was as follows:

- Open issues must be addressed - this was added later to the future steps section.
- The flexibility of the content to suit the context of the vastly diverse target group - Interchangeability was introduced.
- Designing the actual learning material - Detailed in the next section.
- Activities that span the whole module may lead students to lose interest in the classes - Ensuring that there are other engaging class activities too that will keep their attention.

Design phase evaluation

Apart from the evaluation by the jury, a separate evaluation was conducted by a teacher, from a CBSE school in Chennai, Tamil Nadu. The following insights were gathered:

- How would you judge the individual contributions of each member in group activities? When will the

assessments be conducted? - The teacher will have to grade each student individually for all activities including group ones, and it is suggested that it is done during long activity discussions.

- While the content is interesting, the whole structure is very loose and needs some structure.
- Some concerns regarding the feasibility of the activities were shared - For the scope of this project, it is assumed that the school is equipped with the amenities required.

The developed documents were also shown to Ms Monalisa Mukhjeree, an expert in the domain, who used to teach in a school and now currently is pursuing further education. Before the discussion, an explanatory document was sent to her to brief her about the project. The discussion involved taking her through the project, and the individual documents developed and noting down her comments. They are summarized below:

- Overall approach is very interesting, like the ideas that are being taught, explanation document was structured well.
- Umbrella questions can be used to give students (and teachers) an idea of what they will be learning. Could put that up before the whole lesson begins

- All students hate EVS, so need to make the session fun and engaging
- If this is a core subject, we might need textbooks so that kids can read the content later.
- Could make it visually easier for teachers to read the documents if this is an extra subject that they have to take up apart from their regular subjects.
- Compulsory need for reflection at end of sessions or activities
- Too many rubrics may be overwhelming for the teacher

A discussion with one of our professors was held regarding assessments and it was mentioned that similar activities can be graded together and that it was not necessary to evaluate each of the learning objectives separately. He suggested around 4 assessments for a 12-hour module, but the DT team had an assessment at the end of every topic, and therefore that approach was followed.

After receiving this feedback, some more changes were made to the design, like framing the umbrella questions or “Big questions”, and ensuring the rubrics are easy to interpret. After detailing the activities, adding prompts for discussions, and deciding on the time allocation, the development phase began.

Development

Creating the learning materials

The development phase involved putting all of the more minor elements together into the lesson plan, information manual, and task book.

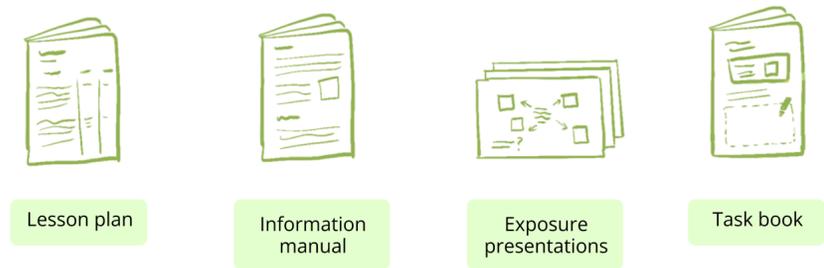


Fig. 19 Set of deliverables

Compiling lesson plan

One of the feedback received was that the lesson plan needs to be in place, with descriptions of how the class would proceed, and what would be discussed, so the lesson plan was initially created, allocating time for various “events” like

- Discussions, mind mapping
- Activities
- Exposure presentations
- Long activity work time
- Home activity

The initial compilation of the lesson plan was done in google docs and is available at [this link](#). The structure of the lesson plan is as follows:

- **Introduction to the module** - contains all the information needed to conduct the module smoothly.
- **Session plan introduction** - a section on how to interpret the session plan and assessment
- **Session plans** - plans for each session with the order of events elaborated in tabular format
- **Activity elaboration** - Activities, materials required, preparation and so on, elaborated in detail
- **Assessment rubrics** - one or two for each topic

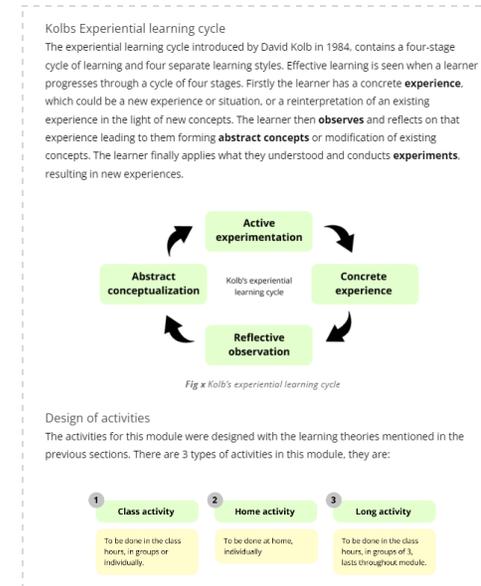


Fig. 20 Introduction to the module - sample page

Events	Materials needed	~Duration
Activity 1: Students pick chits and use the word they picked to write a paragraph Refer to information sheet 1	Chits with words written, basket, timer.	20 mins

Fig. 21 Lesson plan format

Topic 1: Everything is interconnected!		
Events	Materials needed	~Duration
Introduction Get students to settle down.	-	5 mins
Discussion 2.1: Umbrella question - with an example of a tree (only asking open ended questions at this point) <i>Refer to Information sheet 2 (content section)</i>	Picture of a tree ecosystem	5 mins
Activity 2 (Experience) Teacher will read out a story and as students listen, they must map out the story as an ecosystem. They then keep grouping together to create bigger and more detailed maps. They will also suggest changes in the system. <i>More information on Information sheet 2.</i>	Story of the pickle business, paper	40 mins
Post activity discussion: (Observation)		
Exposure presentation (Conceptualization) Explaining how we should take a holistic view while designing for a context, advantages of system thinking, the possible domino effect of seemingly small decisions. Possible entities, kinds of connections. Sample map for Mrs. Preetha's pickle business	Exposure ppt 2	10 mins
Discussion 2.2: Smallest decisions have the biggest impact (example from the same story elaborated by teacher, students guess the impact) <i>Refer to Information sheet 2 (content section)</i>	-	10 mins
Task book exercise (Activity 2) (Experimentation): Students draw their individual maps on activity	Task book	10 mins

Fig. 22 Session plan - session 1

Session assessment					
Topic 1: System thinking Class activity 2					
Criteria (C):					
	1. Creating a visual representation of the ecosystem				
	2. Complexity of the detailed map				
	3. Identifying issues in the ecosystem				
	4. Clarity in representation				
Score/ Criteria	Beginning 1-2	Developing 3-4	Promising 5-6	Proficient 7-8	Excellent 9-10
	Created a visual representation of the system	Created a visual representation of the system and identified some issues.	Created a fairly complex visual representation of the system	Created a fairly complex visual representation of the system and identified issues	Created a fairly complex visual representation of the system and identified issues. Shows general clarity of thought.
C1					
C2					
C3					
C4					
Home activity 2					
Criteria (C):					
	1. Creating a visual representation of the ecosystem				
	2. Complexity of the detailed map				
	3. Answering the prompts				
	4. Clarity in representation				

Fig. 24 Assessment rubric sample

Class Activity 2 - Mrs Preetha Prakash & her pickles	
Individual + Group activity	~40 mins System thinking
Description This activity involves listening to the story of Mrs Preetha Prakash and her pickle business. On listening to the story, the students will have to create an ecosystem of Mrs Prakash's town, its elements in it and its stakeholders. The main product here is the jar of pickles. Students will then observe the ecosystem, various connections and modify them. They will form bigger and bigger groups and create more detailed maps. The teacher will guide the students in the process.	
Why this activity? This activity involves individual and collaborative parts, which helps students to learn from each other and also constructively criticize each other's work. Students are asked to draw the map first with no specific template/symbols so that they can focus on the problem area instead of representation. As they build more and more complex maps, they can better understand the ecosystem better and can provide better solutions to problems.	
Learning objectives	Materials required
1. Create an ecosystem map for a product, identifying the important stakeholder entities (living/non-living), artefacts and the important connections between them 2. Modify the ecosystem map, add or remove connections and loops and introduce new elements if necessary.	Sheets of rough paper, story of Mrs. Preetha Prakash & her pickles, board to write
Preparation	During the activity
The story of Mrs. Preetha prakash & her pickles can be used as it is, or can be modified by the teacher. If the story is being modified, the teacher must create a new diagram, mapping out the new ecosystem.	Ask students to note down their individual contributions in their task books. Groups can sit apart in classroom and are allowed to discuss, and use any resources they wish. If the students wish to refer to the story, they can be given a sheet with the story printed (one per group) or can ask the teacher for details.

Fig. 23 Activity elaboration

Curating information manual

The information manual contains anything that needs to be further elaborated:

- Session wise learning objectives
- Umbrella questions
- Topics and subtopics
- Content
- Material for activities
- Further reading, references

Information sheet 1 - The whats and whys of sustainability

Overview

Why do we need to change the way we make things? This is an introductory session on sustainable design. Students first learn about the change in relationship with resources, and how this trend must not continue. They then learn about sustainability and sustainable design as one of the ways to redirect this trend. They learn about how sustainability is not just about the environment but also other aspects of society too.

Summary of main ideas and topics

Umbrella questions:

Can we continue the current relationship we have with our environment and the resources we take from it? What needs to be done to change that trend?

Other guiding questions:

1. How did we use resources? How did our usage change?
 - a. Transitions of human society
 - b. Understanding how resource use changed
 - c. Do we need to change the way we use resources? How would we do that (with design)?
2. What does sustainability mean for us?
 - a. Is it up to us to "save the Earth"?
 - b. Pillars of sustainability
 - c. Social ecology

Fig. 25 Overview, information manual

Example for the pillars of sustainability: the plastic bag (for discussion 1.2)

From birth to ban: A history of the plastic shopping bag (unep.org)

We all know the impact of plastic and its various forms on the environment. We have witnessed in first hand the issues caused by plastic. What are some of the issues? What changed after they entered the world? Impact to environment - impact to culture (use and throw mentality, short term thinking) - impact to the economy - although production costs may have reduced, the cost of cleaning, disposal and damage to land is beyond anything.

Prompts for discussion:

- What does sustainability mean to you?
- What does the word mean, where do you hear it?
- What role do we play? Do we really need to save earth?
- Is it necessary to be sustainable, design sustainably? How can it be done?

Further reading

1. [Social ecology \(Bookchin\) - Wikipedia](#)
2. [The four pillars of sustainability \(futurelearn.com\)](#)
3. [Human Consumption of Earth's Natural Resources Has Tripled in 40 Years - EcoWatch](#)
4. [The 3 pillars of corporate sustainability - Greenly](#)
 - a. [Sustainable Design Is About Building the Future, Not Just a Structure \(greenbuildingsolutions.org\)](#)

Fig. 26 Content, discussions, information manual

Session activity materials

Material for class activity 2

The following story is to be read out by the teacher as the other students make notes. The story can also be edited to suit the context of the students, so that they find it more relevant to them. The parts highlighted in green can be modified/switched out. Teacher can add more elements to story.

Mrs Preetha Prakash and her pickles

- Mrs Preetha Prakash is an old woman living with husband, son, daughter in law and grand daughter
- Lives in a town, 50 kms from center of city. The town is also known for their export of leaf utensils and packaging products
- The town has most basic amenities like water, sanitation and a recycling plant, and is relatively well maintained by its residents.
- She helps family by making the food and taking care of grand daughter
- Has a nearby mango plantation, her father used to work there
- Likes experimenting with different foods
- Has a nearby industrial estate with different kinds of industries
- She started to develop interest in making pickles from the mangoes in the plantation.
- Her grand daughter suggested that she start selling the pickles she made, and that she would also help in the process. The rest of the family also agreed to pitch in whenever possible.
- So she gets the mangoes from the plantation
- Other ingredients from the local grocery shop
- Brings everything home, started making small batches every weekend.
- The grand daughter helps advertise by printing our flyers with the phone number and the details about the products available.
- Used to use old jars in her own home to pack the products and distribute them.
- Eventually since sales picked up more, Mrs. Preetha made bigger batches of pickles
- For packing the product, they placed bulk orders for plastic bottles printed with a special logo, and custom plastic covers. It comes from a factory near their town 200 kms away, transported using trucks.
- The final products are either shipped to far away customers, or sold in their home itself to local customers.
- Customers, as usual, use the product and throw away the packaging into their translate, which ends up in a nearby landfill.

Fig. 27 Activity material, information manual

The initial compilation of the information manual was done in google docs and can be accessed with [this link](#).

Creating task book

The skeleton of the task book was initially created, with a similar format to the activity description. It contained the learning objectives, a list of the "big questions" and the outline of the activity. Some exercise questions were also formed, and it was ensured that doing those exercises would be part of the class activity. The final contents of the task book are as follows:

- Module introduction

- Learning objectives
 - “Big questions”
 - Class activity outline
 - Time, group/individual
 - Description
 - Instructions
 - Exercise questions/prompts
 - Area to write/draw/stick
- Appendix

The initial compilation of the task book was done in google docs and can be accessed with [this link](#).

Session 1 - Whats and whys of sustainability

Umbrella questions that we will answer ...

- Can we continue the current relationship we have with our environment and the resources we take from it?
- What does “sustainability” mean to us?

Let’s begin with **class activity 1 - Getting my breakfast**

What’s it about?
Whoosh!! You are now transported into a different time period and are a human in that particular time! We have learnt so much about people in different time periods in history class. Can you imagine how people get their breakfasts, how they eat and what they do with their leftovers?
Get into character and prepare a small skit!

Group activity	~50 mins	Skit/ Roleplaying activity
----------------	----------	----------------------------

Instructions

- You will be split into groups and assigned a time period from history.
- Think of how people from that time get their breakfast.
 - Do they have to hunt it?
 - Can they exchange food for other items?
 - Can they pay for food? How do they cook the food?
 - How do they eat it and what do they do with the leftovers?
- You have 20 minutes to prepare, and you have to create a short 5-minute skit
- For further details about the time period, your teacher may provide you with articles, links and content to base your skit. Feel free to go through the internet, if access is available to you.
- Observe your classmates’ skits too, you will have to observe the details, of how habits in humans changed over time and talk about it in the next part of the

activity.

1.1 What is your time period? What role did you play in the skit and why was it significant?
(Space for drawing/writing)

1.2 Once you are done with your skit, fill up the box below with the observations you made about the people from the different times. **What changed, how and why?** Try to answer the **umbrella questions** and feel free to draw pictures or write your thoughts.
(Space for drawing/writing)

Introducing you to the **long activity...**

What is the long activity?
You are now starting out on a mini-project that spans the 6 sessions. This will help you tie everything you learn together and apply your knowledge to come out with a thoughtfully redesigned product!

Group activity	~10 mins	Preparatory activity
----------------	----------	----------------------

What’s it about?
In this session, we will be deciding the groups for the long activity and their topics. Form groups of 3 and pick an object that your group thinks could have been designed more sustainably. *You will be redesigning this object with everything you learn from this module!*

Instructions

- First, make groups of 3 (4 if strength is not a multiple of 3). Try to work with friends you haven’t done projects with in the past!
- Then, your teacher will give you a list of objects for you to pick from, pick one for the group that you think has the potential to be designed more sustainably.
- Submit your group name and object to your teacher at the end of this session.

1.1 Write the name of your group and its members. Mention the chosen object and a few

Fig. 28 Task book sample pages

Exposure presentation content allocation

- It was suggested by the DT team that each topic should have a visually engaging presentation and they could be split into separate presentations.
- The presentation would have to be lightweight and must use minimal text, as some schools which do not have the facilities to share a presentation could print out the slides and show the students.
- A few main topics are allocated to be conveyed by each exposure presentation and were updated at a later stage of the project. The list can be found in [appendix B](#).

How has our relationship with resources changed over time?

Session 1 Exposure presentation

What happens next?

What did we learn from **activity 1?**

Human evolution

↑

→

Their usage of resources

↑

Humans began to need and want more things. Societies became complex. Food stopped being the main motivator for societies.

Fig. 29 Sample exposure slides

Visual design

To understand how to proceed with the visual design, the following was done:

- Observing how existing CBSE textbooks' activity pages and activity books were designed.
- Looking for other science or social science activity books for teens and adults
- Speaking to people with experience in layout design to understand what to look for.

The documents were developed and some samples of the pages are displayed. The documents have been published on issuu, and the links are provided below:

- [Lesson plan](#)
- [Information manual](#)
- [Task book](#)

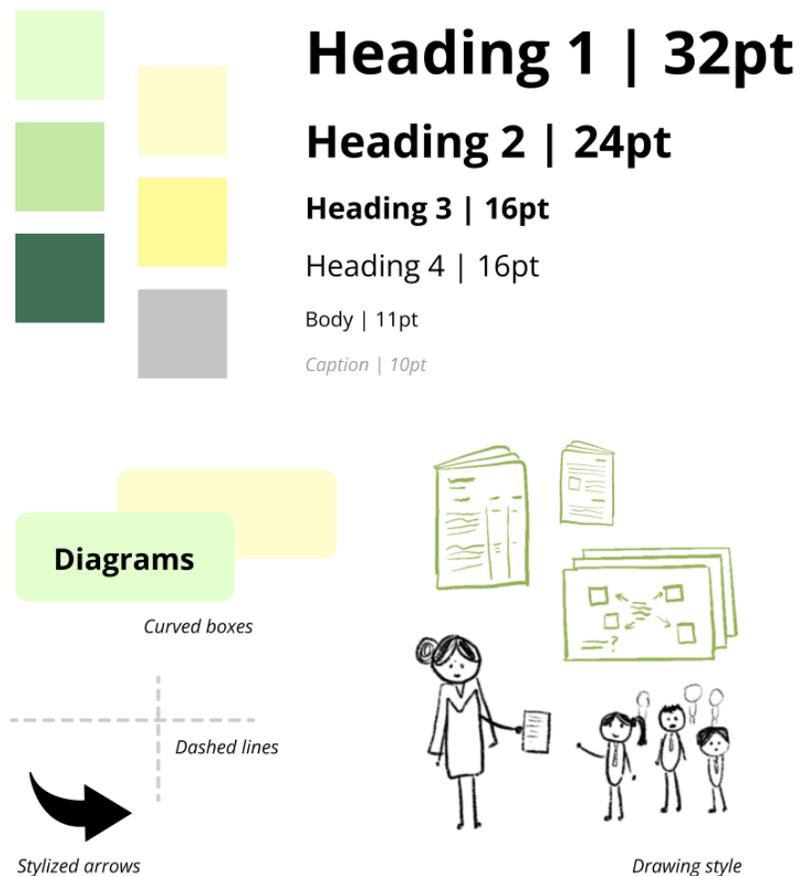


Fig. 30 Chosen style for visual design

Class 10 | Module 6

Sustainability and Design

Lesson plan

Firstly the learner has a **concrete experience**, which could be a new experience or situation, or a reinterpretation of existing experience in the light of new concepts. The learner then **observes and reflects** on that experience leading to them forming **abstract concepts** or modification of existing concepts. The learner finally applies what they understood, conducts **experiments**, resulting in new experiences.

Activities

The activities for this module were designed with the learning theories mentioned in the previous sections. There are 3 types of activities in this module, they are:

- 1 Class activity**
To be done in the class hours, in groups or individually.
- 2 Home activity**
To be done at home, individually.
- 3 Long activity**
To be done in the class hours, in groups of 3, lasts throughout module.

Types of activities

The class activities, along with the content delivery, follows the Kolb's experiential learning cycle, and can be summarized as follows:

Class activities

The class activities are done during class hours, either individually or as a group. They will be based on the story discussed above. The teacher does not "conduct" the activities, but facilitates them, while students take up the dominant role. Eventually, the teacher helps students to understand the idea in the end.

1 | Module overview

Fig. 31 Cover page and module introduction, lesson plan

Session 1

Whats and whys of Sustainability

The big questions ...
Can we continue the current relationship we have with our environment?
What does sustainability mean to us?

Class activity 1 | Getting my lunch

Whoosh! You are now transported into a different time period and are a human in that particular time! We have learnt so much about people in different time periods in history class. Can you imagine how people get their breakfasts, how they eat and what they do with their leftovers?

Get into character and prepare a small skit

Group activity
50 Minutes

Instructions for class activity 1

- Think of how people from that time get their breakfast.
- Do they have to hunt it?
- Can they exchange food for other items?
- Can they pay for food? How do they cook the food?
- How do they eat it and what do they do with the leftovers?
- You have 20 minutes to prepare, and you have to create a short 5-minute skit
- For further details about the time periods, your teacher may provide you with articles, links and content to base your skit. Feel free to go through the internet, if access is available
- Observe your classmates' skits too, you will have to observe the details, of how habits in humans changed over time and talk about it in the next part of the activity.

2 | Session 1 - Whats and whys of sustainability

Exercises

C1.1 What is your time period? What role did you play in the skit and why was it significant?

C1.2 Once you are done with your skit, fill up the box below with the observations you made about the people from the different times. What changed, how and why? Try to answer the big question and feel free to draw pictures or write your thoughts.

If more space is necessary, use an A4 sheet, fold and stick along the grey dotted line

Session 1 - Whats and whys of sustainability | 3

Fig. 33 Session introduction, activity description, task book

Session 1 Plan | Class

Events	Materials	Duration
<p>Topic 1: How did we use resources? How did it change?</p> <p>Introduction Get students to settle down, and start the session by talking about the course, how long it will last, the kind of activities they will be doing and the long activity. Explain to students about what ideas and attitude changes they are expected to leave the course with.</p> <p>Discussion 1.1: What do we already know about resources? How do we use resources now? Is it different from how we used it before? Refer to information sheet 1 (content section)</p> <p>Activity 1 (Experiment) Through this activity, the students have to understand how our relationship with resources changed over time and explain to the teacher who becomes a member of the audience. Further instructions in next section</p> <p>Post activity discussion (Observation) Exposure ppt.1</p> <p>Exposure presentation (Conceptualization) The transitions of human society and what kind of changes in the environment it brought. What happens if we extrapolate these trends?</p> <p>Topic 2: What does the term sustainability mean for us?</p> <p>Mind mapping What does sustainability mean to you? The class goes up to the board and mind-maps their thoughts on sustainability - what does the word mean, where do you hear it, is it necessary? how can it be done?</p>	<p>Some small props, parts of costume from each time period. Task book has further information in appendix</p> <p>Board, marker/chalk or marker</p>	<p>10 mins</p> <p>5 mins</p> <p>50 mins</p> <p>15 mins</p> <p>5 mins</p>

14 | Session 1

Session 1 | Activity Elaboration

Class Activity 1 - Getting my lunch Group 50 mins Skit/Role-playing

Description
Helps students understand that as humans evolved, their usage patterns changed, and as the population increased, humans needed more and more, and faster. The students use the supplementary information provided, create an impromptu skit and explain their thoughts and observations to the teacher who becomes a member of the audience.

Why this activity?
Through this activity, the students have to understand how a simple thing like lunch required different ways to collect resources, and how they handle leftovers could reflect their attitude towards resources. They get more involved in the little things that change as human society progressed and this drives home the point that as society progressed, their impact on their surroundings increases.

Preparation

- The teacher must decide 4 time periods from Indian history for activity 1 (from hunter-gatherers to present-day society). Choices are left up to the teacher to make the activity more relevant for their students.
- Some information about the time periods must be given to the students (printed sheets, articles) and must have:
 - About their lifestyles in general
 - Goals of individuals/societies
 - Daily activities of people
 - Impact of their activities on the environment
- Arrange for very simple props relevant to the time periods or ask students to make them beforehand and reuse them for every year.

Learning objectives
Describe how humans used resources as they transitioned from one society to another.

Materials required
Printed info sheets of each time period, small props & parts of costume from each time period, board to write

Implementation Steps

- Students are given a very short brief about how humans transitioned from one kind of society to another, and about the activity. They are informed that they are to perform a 5-minute skit, and everyone is to participate and contribute. (5 mins)
- They are then split into 4 groups and assigned a different time period - hunter-

15 | Session 1

Fig. 32 Session 1 plan, activity 1 elaboration, lesson plan

Information sheet 4

Overview

At this point, students would have identified many issues in both ecosystem and lifecycle. To suggest appropriate design solutions, can we look into our own lives? Some of our cultures have evolved from old traditions and practices, that was built on the foundations of coexisting with nature. We can take forward many of these principles, use it in creating products and systems, along with new scientific technologies that can augment our efforts

Summary of main ideas and topics

The big question
Are there strategies to sustainability that we can see in our daily lives?
How can usage of sustainable technology help with sustainable design?
Why do grassroots innovations tend to be sustainable?

Other guiding questions

- Can an entire culture be sustainable?
- Examples of sustainable cultures
- Common features of sustainable cultures
- Sustainability strategies
- Sustainable technologies
- Grassroot innovations

Session specific learning objectives

- List sustainable design strategies to be followed while designing products, with examples from their own lives.
- Describe the various kinds of sustainable technologies and provide an example for their application
- Elaborate what is meant by grassroots level innovation and explain why grassroots inventors tend to create sustainable solutions
- Find sustainability solutions inspired by their own context and implement them in the redesign of the product

Linear vs circular economy (for discussion 3.1)

- A circular economy is fundamentally different from a linear economy. To put it simply, in a linear economy we mine raw materials that we process into a product that is thrown away after use. In a circular economy, we close the cycles of all these raw materials. Closing these cycles requires much more than just recycling. It changes the way in which value is created and preserved, how production is made more sustainable and which business models are used.
- A new point is that the current way of thinking about product life cycles is fundamentally linear because there is a raw material extraction phase, a production phase, a use phase and an end-of-life phase. If a life cycle was truly circular, there would be no end-of-life. If there is "final disposal" of a product, such as in a landfill or by incineration, then the system is not circular.
- Even recycling often results in either downgraded material (referred to as downcycling) or less than 100% of material recycled, which does not represent a perfectly circular economy. In fact, if life cycles are truly circular, there would be no raw material extraction. There would simply be the recapture of materials throughout the supply chain and the value chain. Circular economy principles also highlight the ability of organisations to recapture materials through methods like take-back programs that reduce the need to extract new resources.

20 | Information sheet 4

26 | Information sheet 2

Fig. 34 Session introduction, content elaboration, information manual

Development phase evaluation

Presentation to the DT team

The project (before visual design was done) was presented to the DT team, who gave the following feedback

- Putting activities before teaching is interesting
- Content might be a lot for an 18 hour module - this was discussed further later and concluded that it could work the way it is.
- Assessment criteria needs tweaking, can try peer assessments too - this was discussed with guide, told to elaborate on the criteria alone
- Long activity need more criteria to be assessed - criteria was elaborated

On the whole, the members appreciated the effort and mentioned that the activities were interesting.

Discussion with Dr Rupa Agarwal ([Prof. Dr. Rupa Agarwal | NIFT](#))

Dr Rupa Agarwal is the head of clusters at NIFT, and did her PhD at IDC School of design on the topic

“Conjecture-Analysis Model for Integrating Sustainability in Design Pedagogy” which proposes that sustainability can be addressed effectively in the domain of design through Conjecture-Analysis Model for Sustainability (CAMS)

(Conjectures are whole or partial design solutions, which have been implemented in previous instances). This discussion was a continuation of the presentation to the DT team. A summary of her feedbacks and suggestions is mentioned below.

- Iceberg model can be used to teach system thinking - this was later incorporated in the information manual and exposure presentation
- Can use images to explain system thinking, using one picture and analysing all the elements in it to form a system.
- Can include the concept of sustainable consumption

On the whole, she mentioned that it was a comprehensive module but wasn't sure if it would work perfectly with regards to the timing. She also suggested some interesting books to read regarding this topic.

Evaluation

Planning the evaluation

Ideally, the way forward for the evaluation would have been to get a teacher to understand the material and actually deliver it to a class of students over a course of 6 weeks, 2 hours per week, to actually observe how students react to the activities and whether the learning curve of the teacher. Unfortunately, most teachers and students who were contacted were occupied with their final exams during the evaluation stage of this project.

A discussion with Professor Venkatesh was held to understand how to proceed with the final evaluation. To understand how we could evaluate our work, the following was mentioned:

- As the teachers or students can not dedicate as much time, we can do a **qualitative evaluation** with 4 or 5 teachers.
- We would have to take them through all of our work, allow them to read it for a longer time if required and get their feedback.
- The feedback can then be collected and sorted into categories so that we can understand the areas in which the work can be improved.
- He mentioned that conducting physical meetings and printing the material would be ideal.

The **evaluation plan** was decided as follows:

1. Contacting Social science/Science/EVS teachers and briefing them about what we need their help with.
2. Preparing a project briefing document for their reference before the meeting with them.
3. Meeting them on a video call, taking them through the entire material. Allowing them to interact with the documents digitally (Publishing on issuu.com)
4. Noting their feedback and suggestions
5. Collating feedback from all the teachers, grouping similar feedback and identifying the problem areas.

The issues identified were also addressed and solutions to modify the designs are elaborated towards the end.

Recruiting participants

The first step was to recruit teachers for evaluation, and this was done by asking friends and acquaintances. A post on social media was also made to find teachers to evaluate. Eventually, 5 teachers (4 based in Chennai, 1 in Mumbai) volunteered to participate. Their names have been hidden for privacy, but the details of the school and their positions have been tabulated below:

School	Role
S. K. Somaiya Degree College, Navi Mumbai	Teaching Intern, environmental sciences domain - Completing B.Ed
Mahindra world school CBSE, Chennai	Social science teacher, class 10
Mahindra world school CBSE, Chennai	HOD of social sciences dept & Social science teacher, class 10
Vidya Mandir, Estancia, Chennai	Social science teacher, class 10
PS Senior school, Mylapore, Chennai	Social science teacher, class 10 (Retired)

The list has teachers who are all female and of varying ages and experience levels. They are from both conservative and experimental schools.

Briefing participants

The volunteers were contacted through a phone call and briefed in short about the project and the time I would need them to spend in evaluation. Unfortunately as they were busy with exam duty, they could only contribute around 1 hour for this evaluation. Therefore, they were given a simple project explanation document which had a gist about the project so that we could go spend lesser time during the evaluation on the basic explanation.

Project briefing document

The document was made in google docs and contained the following information:

- About the design thinking elective
- About the module
- About the learners
- Structure of the module
- Learning materials created
- What is required from you

The link to the document is provided [here](#).

Meeting format

A link to the online meeting was sent to the teachers initially. A brief self introduction was done in the beginning, after which the basic details of the project was presented for 15 minutes. The link to the presentation used is [here](#). In the end of the presentation, the learning materials are introduced, after which the teachers were asked to interact with it on the issuu site. As they flipped through the pages, they asked questions, and gave feedback and suggestions, which was noted down. Once there was no more feedback to be mentioned, the volunteer was thanked for their time and the meeting ended. Some teachers continued to give feedback and sent images of the existing material they used

even after the evaluation session. Their response was on the whole positive, more about this will be elaborated in the next sections.

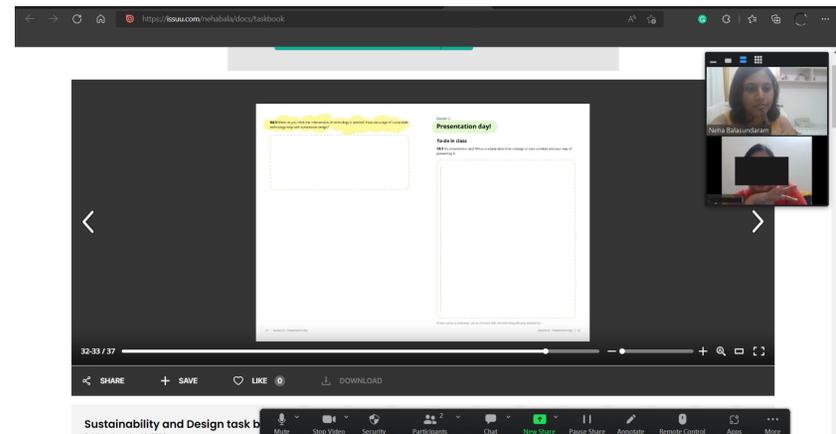


Fig. 35 Screenshot of meeting with participant

Consolidation and classification of feedback

Finally, the discussion was transcribed, the main pieces of feedback were identified and grouped together. The feedback was clustered, and some common feedback began to emerge out of the clusters. Some of the feedback was specific to different parts of what was presented. Feedback was also grouped in terms of general issues.

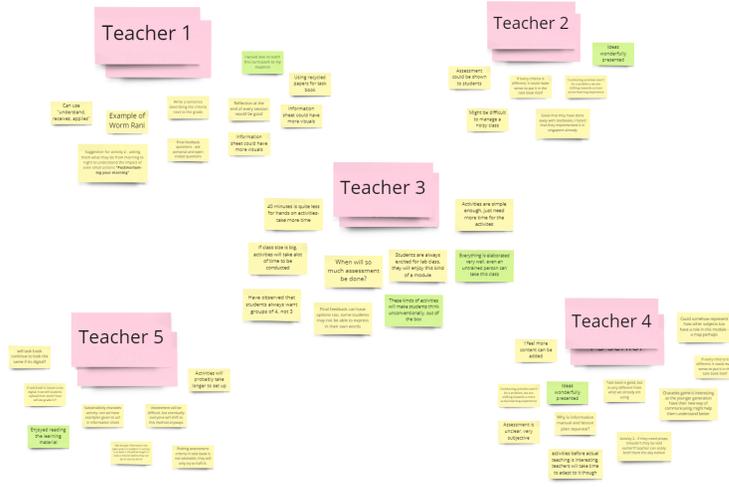


Fig. 36 Feedback from each teacher ([link to pdf](#))

- **Activity specific suggestions** - these were some tips on making sure the activity ran smoothly, although some alternative activities were also suggested.
- **Session plan being hard to interpret** - representing it in the form of a flow diagram was one of the remedies suggested

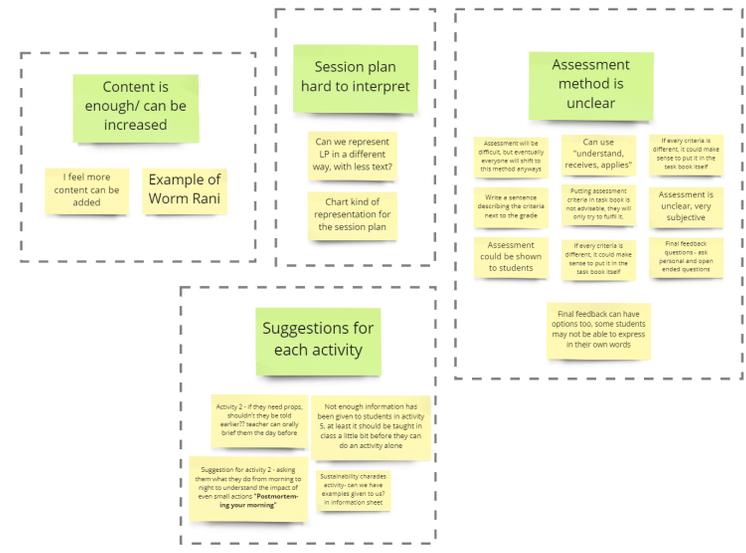


Fig. 37 Feedback about specific elements

Similarly, the general feedback is as follows:

- First, the feedback about specific elements:
- **Amount of content** is either enough or can be increased - although most of the domain experts mentioned that the content may be too much, the teachers think otherwise
 - **Assessment methods** are unclear/need clearer criteria/placing assessment in the task book/ modifications to attitude shift assessment - the assessment proved to be the most problematic area of all. Suggestions were also given as to how to make it better.

- Issues with **structure** of class/ learning material
 - Why is information manual and lesson plan separate?

- Could have a reflection session at the end of every session
- **Doubts about presentation** of material
 - How will task book work if it is meant to be digital?
 - Could recycled paper be used for the task book? Will emphasize the idea further
- **Timing** issues
 - Activities will consume more time than what is allotted
 - Assessment needs a lot more time
- **Novelty** but too different from existing methods
 - It may take some time for teachers to adapt to these kinds of methods
- **Feasibility** of these things may be hard
 - Class might become too noisy
 - When will teachers conduct assessment for each student?

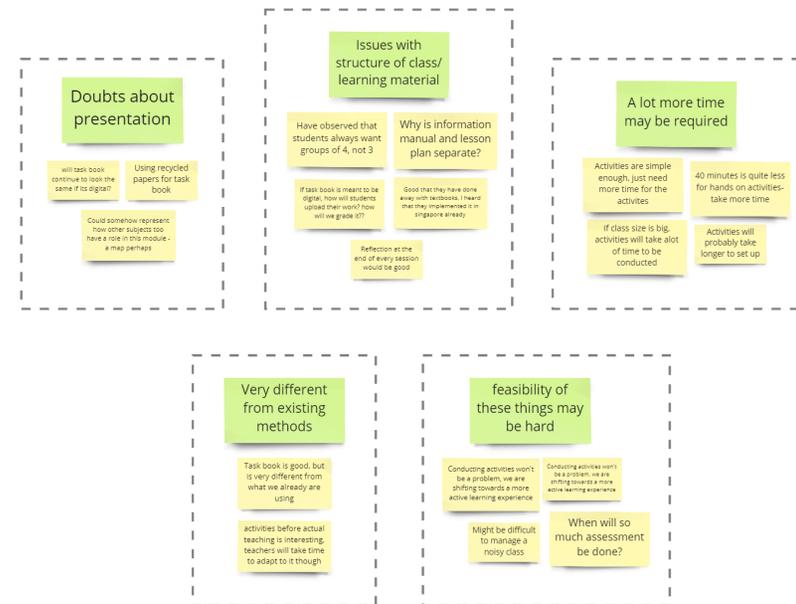


Fig. 38 Feedback about general issues

The next step was to address all of these issues. The remedies proposed for all the issues identified are elaborated in the next section of this report.

Next steps

Addressing the identified issues

Addressing these issues would constitute the second iteration, but since this project is of a shorter duration, only the first iteration has been completed. Some solutions for these issues have been suggested in this section.

- **Amount of content is either enough or can be increased** - speaking to more social science teachers and domain experts (in domains like sustainable design, design, sustainability) can help perfect the content. Adding more content may cause timing issues.
- **Assesment methods** are unclear/need clearer criteria/placing assessment in the task book/modifications to attitude shift assessment.
 - The criteria can be defined better on further discussions with teachers.
 - Many teachers suggested moving the assessment to the taskbook itself, but the students will have to take their books home for doing their home activities, so maybe assessment can be done during the long activity sessions, as students are discussing among themselves.

- **Activity specific suggestions** - these can definitely be incorporated, if it does not prolong the activity further.
- **Session plan being hard to interpret** - advised to represent it in a more easy to interpret format. The proposed method of representation is shown below:



Fig. 39 Proposed format for lesson plan

- Issues with **structure** of class/ learning material
 - Why is information manual and lesson plan separate? - They could be combined together

as they both contain information needed to conduct the sessions.

- Could have a reflection session at the end of every session - Although there are questions in the task book that ask students to sum up their learnings, it is important to sum up what one has learnt together as a class.
- Doubts about **presentation** of material
 - How will task book work if it is meant to be digital? - This may require a separate interface to be created, where students can take pictures of their work and upload it, and also access the presentations used by the teachers
 - Could recycled paper be used for the task book? Will emphasize the idea further - although there are some restrictions on how the task books are created, maybe the paper they use in class could be one-sided or recycled paper.
- **Timing** issues
 - Activities will consume more time than what is allotted - Activities may need to be simplified further, to ensure that fun learning is given priority while not compromising on the rest of the session.

- Assessment needs a lot more time - Assessment can be done during the long activity periods, where students may be working with themselves. Nevertheless, assessment should be made easier to do.
- **Novelty** but too different from existing methods
 - It may take some time for teachers to adapt to these kinds of methods - this is a very valid issue but we could ease the process by understanding the way it is represented currently in teacher's manuals and transitioning away from it slowly.

Open issues identified

Throughout the course of this project, including the feedback given by the teachers, many issues were identified, but were too difficult to address within the duration of this project. They have been outlined here.

- **Teacher-teacher interaction not addressed, the learning curve may be high for teacher-** This was discussed with the guide, and it was decided that we will assume that the teachers are competent and motivated to teach this subject, as addressing it would not be feasible for a 4-month long project.
- **Content may not be appropriate** - For the sake of this

project, it is assumed that the content is curated correctly so that the other parts of the instructional design process can be completed. Most of the content is from reputed articles and papers.

- **Conducting evaluation with a good representation of the target group is not possible** - Since we did not have access to students and teachers who represent such a large target group, the evaluation of the design will only happen with city schools or at most suburban schools.
- **Availability of resources to conduct the activities** - It is assumed that the schools will be equipped with the needed resources as told by the CBSE team.
- **Assessment rubrics are too simplistic** - The exact rubrics which will be used have not been decided yet by the DT team, and therefore for this project, a 10 point grade is used.

Possible novelty effect

It is possible that since the current CBSE curriculum is very bookish, an active hands-on module such as the one developed in this project may have caused the participants (teachers) of the evaluation respond in an overwhelmingly positive manner, since they haven't been exposed to these kind of teaching methods. One can only tell if this is true based on longer evaluation studies.

Conclusion

One can consider this project to be the first iteration in many iterations of the development of this module. Based on the feedback, with further evaluations and modifications, it could prove to be an effective module to teach sustainability and design. The major drawback was that due to the unavailability of students at the time that the projects were being done, the evaluation had to be restricted only to teachers. Other open issues were also identified towards the end, and if this project is taken forward for further development, those issues could be dealt with. Nevertheless, most of the requirements to conduct a module were covered in this project and one iteration of Analysis - Design - Development - Evaluation has been completed.

Reflection

As I worked on this project, I have grown so much both as a designer and as a person. I received so much help from the people around me and I will always be grateful for that. This project helped me test out my instructional design skills and I got to delve much deeper into the domain of sustainability and sustainable design. I thoroughly enjoyed speaking to the domain experts, who engaged in interesting conversations and even recommended readings and topics to read up on for my personal growth. It was very interesting to see various approaches people take towards sustainability, and finding a middle ground and understanding how it applies to design was a challenging task. Looking at the level of involvement that the teachers that I interviewed had in helping me with my project was really inspiring, and it was interesting how they were able to point out mistakes that seemed very obvious later. Last but not the least, hearing kind words from the teachers about how I did a great job really motivated me. On the whole, it was a very enriching experience!

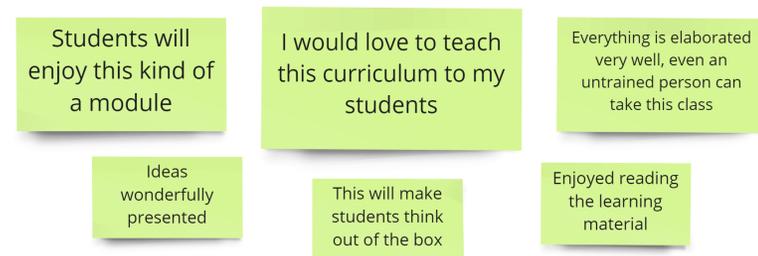


Fig. 40 Appreciation from teachers

Appendix

(A) Session-specific learning objectives

Session 1: What's and Why's of sustainability

1. **Describe** how humans used resources as they transitioned from one society to another.
2. **Justify** why the trend of intensive resource usage by humans can not continue.
3. **Elaborate** on the different pillars of sustainability, and the importance of achieving equal progress in each of the pillars.
4. **Analyze** the positive and negative impact of an object in the different pillars of sustainability.

Session 2: Look, its a system!

1. **Explain** how viewing the entire context of any product can augment the design process.
2. **Create** an ecosystem map for a product, identifying the important stakeholder entities(living/non-living), artefacts and the important connections between them

3. **Modify** the ecosystem map, add or remove connections and loops and introduce new elements if necessary.
4. **Speculate** the possible impact and consequences of a product or changes made to the ecosystem map.

Session 3: Resource to product to... resource?

1. **Describe** the lifecycle of an object and the different phases of a lifecycle using examples.
2. **Differentiate** between a circular and linear lifecycle with an example and identify the advantages and disadvantages of both
3. **Create** a product lifecycle for an object by collecting information from it's manufacturers, people who use it and those who handle its disposal.
4. **Identify** issues in each phase of the lifecycle and suggest alternative solutions

Session 4: Sustainability strategies & technologies

1. **List** sustainable design strategies to be followed while designing products, with examples from their own lives.

2. **Describe** the various kinds of sustainable technologies and provide an example for their application
3. **Elaborate** what is meant by grassroot level innovation and explain why grassroot inventors tend to create sustainable solutions
4. **Find** sustainability solutions inspired by their own context and implement them in the redesign of the product

Session 5: Final presentation

1. **Redesign** the chosen product using sustainability strategies and modify the ecosystem map/lifecycle accordingly.
2. **Present** redesign in a concise and creative manner
3. **Defend** their choices for the redesign and answer the questions posed by teachers and classmates.
4. Constructively **criticize** other teams' redesigns, pointing out what went right and what went wrong.

(B) Exposure presentation content allocation

Presentation 1: What's and Why's of sustainability

The first part of presentation 1 talks about the transitions of human society and what kind of changes in the environment it brought, what happens if we extrapolate these trends?

- Big question: Can we continue the current relationship with our environment and the resources we take from it? What needs to be done to change that trend?
- Humans, as they evolved, have caused more and more impact on the environment.
- Let's extrapolate these trends - what are the upcoming trends - Digital currencies, Population (one that requires comfort above all) increase, Rate of extraction of fossil fuels
- How would the future look if we continued this trend?

Second part of presentation talks about the concept of sustainability, trying not to use complex words and explain in simple, relatable terms.

- Resources available to us are finite.

- Are we using things up too fast? Before they can get restored?
- We all use electricity, which mainly comes from coal - how fast are we using coal compared to how fast is it generated?
- Sustainability is a continuously evolving journey, not a goal.
- We need to change the way we use things, and a way to do that is to change how we design the things we use
- Example - Chips packets - can they be ziplock - Amazon packaging - even 1 layer reduction can lead to a lot of change - bubble wrap vs new cardboard packaging.
- Let's learn how we can design the things we use more sustainably.
- The final question to think about: Is it really up to us to "save the earth" or are we just trying to save ourselves?

The final part of presentation covers the pillars of sustainability - Sustainability is not just measured in terms of what happens to the environment, but also in society and the economy.

- Looking at the effects of the plastic bag, we can see that it's not only on the environment but also on the people, the culture of use and throw and economic destruction
- Pillars of sustainability economic, social, ecological, cultural
- Examples for each
- Concept of social ecology - how we treat the environment is how we end up treating our fellow beings

Session 2: Look, its a system!

This presentation explains how we should take a holistic view while designing for a context, the advantages of system thinking, and the possible domino effect of seemingly small decisions. Possible entities, Kinds of connections. Sample map for Mrs Preetha's pickle business

- Are the things we use independent of everything else? Can we view anything as a part of a bigger system?
- Going back to the example of the tree ... we can think of it as a system. And it is a part of bigger systems like forests... Which is part of a huge system called earth.
- Whenever we make a decision, including a design

decision, we need to look at the possible consequences

- Of course, we can't judge every consequence, but we can try our best to visualise the consequences of how we design things - even after designing them, we can keep improving them based on their effects on the system around them.
- How can we understand the systems around us? Techniques to visualize systems - kinds of elements, relationships, loops
- An example of how we can visualize Mrs Preetha's pickle business

Presentation 3: Resource to product to... resource?

This presentation explains how everything comes from the earth, has a lifecycle and ends up on earth again. Phases of lifecycle linear & circular, making linear into circular.

- How are things made? How can we ensure what we take from Earth is utilized fully and returned?
- Everything we make begins on earth and ends up back on the earth. The difference is that it is modified, and is not returned back in the form it was taken.
- Everything has a product lifecycle - the difference btw

this and the previous exercise is that this looks at how resources change form, other looks at the impact a product has on seemingly unrelated things too.

- Explanation of lifecycle with Mrs Preetha's pickle example (material extraction, manufacturing, distribution, use and disposal)
- Linear and circular cycles - example of businesses that collect the containers after customers use the product

Session 4: Sustainability strategies & technologies

First part of this presentation explains some of the strategies discussed with contextual examples apart from how we can design stuff, we can think about what we can use to design it

- There is no specific path to sustainability, but we can only use some guidelines or strategies.
- Example of all strategies, with a prompt for kids to give examples before showing the examples.
- Along with strategies, new technologies can also help us mitigate existing sustainability problems, use and produce renewable energy and design more efficiently. (Prompt for discussion)

Second parts explains different kinds of sustainable technologies, some examples of cutting edge tech that has helped solve sustainability problems.

(C) Important links

- Initial ideation of activities-
https://drive.google.com/file/d/1hYGOrt6gaFuXD0l3RUs0_KE2V4cQFCys/view?usp=sharing
- Summary of all activities -
<https://drive.google.com/file/d/1Lc8UDTZm1DDSOW8YrVKRlo5IFMZA1sz9/view?usp=sharing>
- Lesson plan (google docs) -
https://docs.google.com/document/d/1XzTw6_JmeNDIMlC-t4Njv3A2Pkg28yjPkSAHU6vlpRY/edit?usp=sharing
- Lesson plan (Issuu) -
<https://issuu.com/nehabala/docs/lessonplan>
- Information manual (Google docs) -
<https://docs.google.com/document/d/11BkNdWMOkb9PWvXaepAysqMD2RjldgHOIUlp2V60kbg/edit?usp=sharing>
- Information manual (Issuu) -
<https://issuu.com/nehabala/docs/informationmanual>
- Task book (google docs) -
<https://docs.google.com/document/d/1CSygzVeRG2H4Ms3dF1wqgvPAIqcrV2cvePV-GRL70Oc/edit?usp=sharing>
- Task book (issuu) -
<https://issuu.com/nehabala/docs/taskbook>