

The Complex Problem Solving Project: A Guide to Improving Our Own Community (Lesson Plan)

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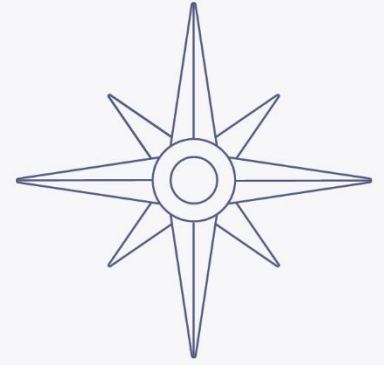
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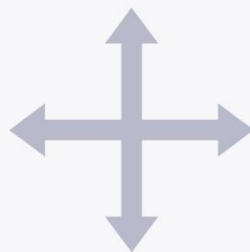


The Complex Problem Solving Project



A GUIDE TO IMPROVING
OUR OWN COMMUNITY

Enhancing Critical Thinking and Creativity Skills



The Complex Problem Solving Project

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**The Complex
Problem Solving Project**

A Guide to Improving Our Own Community
Teaching and Learning Lab, Kyushu University Faculty of Design



Teaching and Learning Lab, Kyushu University Faculty of Design

<https://life-green-peace.org>

This resource package is an educational prototype produced by the Teaching and Learning Lab. We are hoping to understand the usefulness of these materials and how we can improve them to make them better for educators and learners. At the same time, through the feedback, we also hope to create new resources for educators and learning through research and development. If you have used these materials, please share your feedback with us in this survey.



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Acknowledgment

Leading towards the creation of these resources, our lab has visited secondary and high schools in Oceania and Asia to understand the common approaches teachers use in their teaching subjects to teach students to solve complex problems. At the same time, through the sharing by the teachers, we were able to catch a glimpse of the challenges faced by the teachers when facilitating and teaching complex problem solving. The generous insights from the teachers have contributed to the motivation and ideas for these resources.

We would like to express our appreciation to all the staff, teachers, and professors for their help in coordinating our school visits in their countries.

In addition, we would like to thank the following faculty members at Kyushu University for their valuable insights and advice in this project.

Dr. Melanie SARANTOU (Professor)

Dr. Yanfang ZHANG (Associate Professor)

Dr. Moe SHIMOMURA (Associate Professor)

Dr. Noriko TAKANO (Researcher)

Preface

There is no doubt that complex problem solving is one of the most important competencies that our students should possess to navigate the rapidly changing and uncertain future. Why is it so? Doing a search on the World Wide Web, we will be able to find many books, resources, and information that explain what complex problem solving is, its importance, and how to develop complex problem solving skills. National curricula in many countries have also been designed to systematically develop complex problem solving skills in students. Through solving complex problems, students develop important attributes necessary for the 21st century.

Complex problems can be associated with ill-defined problems. Ill-defined problems are like the real-world problems that we face daily. During my research journey, I often found students learning how to solve complex problems in subjects such as Design and Technology; in some countries, the subject is called Technology. In Design and Technology, students are taught how to use the design process to solve real-world problems. Besides Design and Technology, school curricula in some countries consist of a dedicated subject for students to be engaged in project work. During project work, also known as complex problem solving projects, students are often taught to use design-based approaches to solving real-world problems. While some teachers are trained to facilitate complex problem solving projects using design-based approaches, many are not. Some teachers may be trained in teaching a specific subject area; some are beginning teachers with less experience than others. For this reason, our team in the Teaching and Learning Lab at Kyushu University started to conceptualize this project that aims to develop a set of resources as a “starter kit” for teachers to embark on facilitating and teaching complex problem solving in their classrooms.

Our set of resources is designed to enable teachers to initiate a complex problem solving project in their classrooms. In this project, students will explore real-world problems within their communities, with the overarching goal of contributing to a sustainable world by achieving the Sustainable Development Goals (SDGs) through their creative solutions. The general approach to solving real-world problems in this project is adapted from the design process used by design practitioners and academics. While the design process can be defined in various ways, our team has attempted to articulate it through a story, providing teachers and students with a more general approach to solving real-world problems.

Through solving real-world problems in this project, students will develop various competencies. Firstly, students will need to integrate knowledge and skills learned in different subjects to understand the problem and create suitable solutions to solve the problem. Through understanding the problem, students may better understand their communities and connect with their cultures, history, societies, etc. Secondly, through solving real-world problems, students will also need to exercise critical thinking to make good decisions, creativity to create original ideas, social-emotional learning to empathize with the issues faced by others, communication skills to connect with stakeholders, and many more.

This set of resources is mainly written with the following users and learners in mind.

- a. Beginning teachers (secondary/high school teachers)
- b. Teachers unfamiliar with facilitating and conducting complex problem solving projects
- c. Secondary and high school students

While we admit that there are many strategies to conduct and facilitate complex problem solving projects, our team hopes these resources will serve as a starting point for some teachers and be useful for them and their students. Teachers may also adapt the content of the resources to implement the project in a way that suits their classroom and students best.

Leon LOH

The Complex Problem Solving Project Package

This package consists of four items designed to be used hand in hand with each other.

Main items in this package:

- Lesson Plans
- Guidebook
- Workbook
- Worksheets

This project is planned as a short curriculum for teaching complex problem solving. The curriculum is planned for 18 Lessons. Each lesson is suggested to be 100 minutes. Activities planned in each lesson include individual and group work.

This complex problem solving project is designed for upper secondary/high school students. Students in the class are suggested to work in groups. The recommended size of each group is about four.

How to use the resources?

1. The lesson plans consist of the following content to suggest how teachers can conduct each lesson in the project.
 - Learning Objectives
 - Detailed plans, including the purpose of the content/activities, teaching strategies, materials needed and time allocation
 - Facilitation notes which pre-empt teachers of possible issues that may happen, suggestions of what they can do, what they can prepare beforehand, etc.
 - Suggested references and resources for further reading
2. The guidebook provides concise content information, examples, and references for further reading that students will need for the project.
3. The workbook provides activities to facilitate students' learning, and it serves as a journal in which students record all their learning, research, and thoughts during the project.
4. The worksheets are designed in A3 size for individual work and group discussion.
5. Teachers can use the resources in the following ways.
 - Use as it is.
 - Extract relevant activities and materials to adapt to your curriculum.
 - References to design your curriculum and materials.

Lesson 1: Understanding the Project Task and Awareness of SDGs Efforts

Learning Objectives:

1. Students will be able to understand real-world problems.
2. Students will be able to understand the process of solving real-world problems.
3. Students will be able to understand the purpose of the SDGs and the global effort needed to achieve them.
4. Students will be able to understand that different countries have different problems, and some of the issues related to SDGs are more urgent for some countries to address some issues than others.
5. Students will be able to understand that issues are tackled at different levels—global, country, prefecture, community, and individual.
6. Students will be able to understand the project task and the importance of it.
7. Students will be aware of the SDGs efforts of different people, communities, and organizations.

Understanding The Project Task		
Purpose A clear understanding of real-world problems, the process of solving real-world problems, the SDGs, the different issues faced by different countries, and the different scales of issues that are solved at different levels is necessary to provide students with awareness and direct them to explore real-world problems in their community within their scope of work and the given time. We are not discouraging the students to think big. However, to do that, students need time to understand and explore the solutions, which may be systemic issues that can only be resolved with multiple solutions and approaches. We hope students can understand a problem within their scope and within their limited time well enough to design a feasible solution.		
Content	Materials/ Equipment required	Time allocated
• The purpose of the project and the project task. • What are real-world problems? • What is the difference between well-defined problems and not well-defined problems? • What is the process of solving real-world problems? • The process can also be explained using the story of the brave explorer. • What are SDGs? - Teachers can use the UN video to introduce SDGs. - Highlight that SDGs are global targets. Every country has different problems to address. - Explain and show with examples that issues are tackled at different levels: global, country, prefecture, community, and individual. • Teachers can use the case study of Flashflood Inc. to lead a class discussion on solving real-world problems. Students can be given 10 minutes to read the article before the discussion on the following: - Domingues's process of solving real-world problems. How did Domingues identify the problem? What research has he done?	Guidebook Personal learning device	50

Who has he spoken to? What was the idea? Who did he work with? - Why does this issue matter to him? - The impact of Domingues's effort on his community and the country. Highlight how his effort impacts a global scale, where less food is wasted, less wastage of natural resources are used to produce the food, less carbon emissions are used to transport the raw materials, etc., thus achieving many SDGs. • Provide an overview of the timeline and clarify project expectations, assessment methods, and criteria.		
Facilitation Notes • This part could be content-heavy for students. However, students do not need to know everything in depth. Some content, such as the real-world problem-solving process, can be better understood as they embark on the project. Using the case study is a way to help students relate to the real-world problem and the process. Teachers can prepare some questions for discussion in groups if time permits. Alternatively, teachers can use a flipped classroom strategy to get students to read some of the contents at home before the class and create more discussion time in class. • The guidebook includes examples and links teachers can use to explain SDGs. However, it would be better if teachers could use some examples from local contexts that students can relate to or get to know the community or country better. • Teachers need to consider the project's expectations and the assessment criteria, which could include formative and summative assessments. Formative assessment should be provided to the students throughout the project process to improve their learning. Teachers can decide the assessment criteria according to school needs.		
References and Resources 1. George Lucas Educational Foundation. (8 May, 2024). <i>Empowering Students to Be Real-World Problem Solvers</i>. Edutopia. Retrieved January 7, 2025, from https://www.edutopia.org/video/empowering-students-problem-solve-real-world. 2. Pierron, J. (12 October, 2022). <i>Josh Domingues of Flashfood Shares What Makes the Company's Waste Reduction System So Effective</i>. Waste 360. Retrieved January 7, 2025, from https://www.waste360.com/food-waste/josh-domingues-of-flashfood-shares-what-makes-the-company-s-waste-reduction-system-so-effective 3. United Nations. (19 September, 2022). Red Alert - How to meet the Sustainable Development Goals together SDG Moment United Nations [Video]. YouTube. https://www.youtube.com/watch?v=wXASRXbjR08. 4. Harvard University. (n.d.). <i>Flipped Classrooms</i>. Retrieved January 7, 2025, from https://bokcenter.harvard.edu/flipped-classrooms.		

Understanding The Importance of the Project Task		
Purpose It is important to discuss with students the significance of this project and who and why it matters. The impact they can make with this project on their community and how their effort can contribute to the country and inspire many to join them and, in turn, how these will impact the world. Finally, how can all these accumulations of good bring good to them? It is important to help students understand the relevance of this project and develop students' sense of purpose before they start it. If they see the meaning of the project, they are more likely to be motivated intrinsically.		
Content	Materials/ Equipment required	Time allocated
- Why is this project task important? - Teachers can use the 3 Whys thinking routine developed by Project Zero, a research center of Harvard Graduate School of Education, to get students to reflect on the significance of this project on their own in the workbook. ➤ Why might this project matter to me? ➤ Why might this project matter to the people around me? ➤ Why might this project matter to the world? - Then, share with group members and note down views that are different in the workbook.	Guidebook Workbook	20
Facilitation Notes - Teachers should help students become aware of the impact and consequences at the personal, local, and global levels if nothing is done to address the issues. Teachers can think of a relatable example that might initially seem remote, but eventually, it will affect the students. - The 3 Whys thinking routine can help students make connections between taking action and its implications on a personal, local, and global level. We hope students can develop a sense of purpose and responsibility to their community. Getting students to articulate the 3 Whys and write them down is a reflection and internalization process of this project's purpose and commitment to achieve them. - The students will develop and apply critical and creative thinking skills throughout the project. They are also encouraged to ask questions. Teachers can consider how to introduce and start a culture of thinking in the class using the Habits of Mind or Visible Thinking routines.		
Reference and Resource - Harvard Graduate School of Education. (n.d.). <i>The 3 Whys</i>. Project Zero. Retrieved January 7, 2025, from https://pz.harvard.edu/sites/default/files/The%203%20Whys_0.pdf. - Institute for Habits of Mind. (n.d.). <i>What are the habits of Mind?</i> Retrieved January 7, 2025, from https://www.habitsofmindinstitute.org/learning-the-habits/. - Harvard Graduate School of Education. (n.d.). <i>Visible Thinking</i>. Retrieved January 7, 2025, from https://pz.harvard.edu/projects/visible-thinking. Project Zero.		

What has been done for SDGs? What can you do for SDGs?		
Purpose This activity is for students to understand that there are many SDG issues to be solved at different levels, and the resources will provide some ideas of the problems and solutions that people have done as an inspiration for them to uncover issues related to SDGs in their community that they can solve. Each resource's question(s) served as reflection questions to draw a connection between what the students have read or watched and their community. They also serve as examples for students to think about possible problems around them and what they can do. The opportunity for students to reflect on and learn from everyday situations and the examples of others has the power to influence their capacity to act responsibly.		
Content	Materials/ Equipment required	Time allocated
- Students explore the SDGs resources provided through the link in the guidebook to understand the SDGs efforts done by different people, communities, and organizations. - The resources are organized according to themes. Students can choose the areas that they are interested in. Each resource is accompanied by question(s) to reflect on the material read or video watched. - Students can take notes in their workbooks as they read or watch the resources on areas that interest or inspire them. They can continue viewing the resources after class. - After viewing the materials, students can write their reflections in their workbooks under "What can I do for SDGs?" - Students can continue the work at home. Students should be given sufficient time to explore, think, and ponder what they have learned.	Personal learning device WiFi Guidebook Workbook	30
Facilitation Notes - Teachers may read and watch some of these resources before class to consider what students can do for their community. The reflection questions direct students to think and wonder what they can do at home, in school, in the city, etc. They serve as an example of how students can explore real-world issues around them. - Teachers can encourage students to read more about SDGs through the links in the guidebooks or search for more examples on the Internet. Researching and reading will help them broaden their knowledge and think deeper. - Teachers can use similar reflection questions in the earlier resources to prompt students who are unsure what they can do for the SDGs. If teachers know the students well, they can suggest some areas that the students may be interested in. - Teachers may need to constantly remind students to think of what they can do for SDGs within their means and limited time throughout the problem-finding process to keep them focused. If they successfully derive innovative solutions that impact their community, it will likely motivate them to continue the SDGs journey independently or as a group.		

Lesson 2: Exploration of Real-World Problems

Learning Objectives:

1. Students will be able to use mind maps and questions to explore and identify issues related to SDGs within their community.
2. Students will be able to identify real-world problems in their community.

Sharing of the Student's Reflection on SDGs		
Purpose Sharing the students' reflections in class helps reinforce what they have learned and inspires each other for a good cause. It serves as the preamble to this week's lesson.		
Content	Materials/ Equipment required	Time allocated
• Students shared their reflections in their groups or as a class through strategies like “Think, Pair, Share” or online platforms such as mentimeter.		15
References and Resources 1. Harvard Graduate School of Education. (2015). <i>Think-Pair-Share</i>. Project Zero. Retrieved January 7, 2025, from https://pz.harvard.edu/sites/default/files/Think%20Pair%20Share_2.pdf. 2. Mentimeter. (n.d.) <i>Live Q&A</i>. Retrieved January 7, 2025, from https://www.mentimeter.com/.		

Introduction to Exploration of Problems		
Purpose The students are to explore problems related to their community and SDGs. Their lives may mostly revolve around school and home, and they may be oblivious to their surroundings. It is important to nurture their curiosity, observation skills, care for people, and ability to draw connections to identify problems related to their community and SDGs. Two strategies are used to develop these skills: thinking deep with questions and thinking wide with mind map.		
Content	Materials/ Equipment required	Time allocated
• Students need to remember that the project's purpose is to solve a real-world problem, make a difference in our community, and achieve the SDGs, as they have read or watched on the resources. • Students need to be observant, think deeply, and be interested in and caring for people to explore problems in their community. • Students will learn two strategies to help them uncover problems and areas for improvement in their community. • The A3 Community Sheet provides students with a visual of what is in their community and questions they can ask and ponder as they observe their community.	Guidebook A3 Community Sheet (One for each student)	5

Think Wide with Mind Map		
Purpose Mind maps are a good tool for students to recall what they already know. Then, use questions to think deeper into possible problems.		
Content	Materials/ Equipment required	Time allocated
• What is the purpose of the mind maps? • Demonstrate to the class how to use a mind map to expand their thinking. • Each student is given an A3 Mind Map Sheet to create a mind map of problems and improvements that can be made to their community. • Students can explore possible problems using different first-level associations, such as places, different groups of people, SDGs sub-goals, etc., and refer to the examples in the guidebook. • Students can note down words or short phrases in the mind map and refer to the examples in the guidebook. • Students can refer to the earlier resources and reflection questions to think about problems or improvements. They can record some of the problems and issues learned from the earlier articles and videos. • Students can search the internet to find problems experienced by different groups of people. • Students have to create a comprehensive mind map of possible problems related to their community. • The mind map will help students recall and explore their community's different places, facilities, people, objects, etc. However, how can they think deeply to uncover problems or inconveniences people face? This leads to the next part of the lesson.	A3 Mind Map Sheet (One for each student) Guidebook Personal learning device WiFi Workbook	20
Facilitation Notes Students may be at a loss when given a big piece of paper to attempt the mind map. It is important to provide students with some suggestions on the first—and second-level associations to get them started exploring them widely, especially if they are new to creating a mind map. It is also important for teachers to demonstrate how to create a mind map with the class to guide students in thinking. Students can create the mind map after teachers explain mind maps and how to use questions to help them uncover problems. Also, four examples of mind maps are provided in the Student Guidebook. Examples 1 to 3 use different first-level associations and guidelines to create mind maps. Example 4 shows a mind map that uses a combination of first-level associations and random thoughts. In reality, the way we think can be random. They may not follow in a structured way. The examples provided do not show the whole comprehensive mind map because we don't want students to copy from the examples. However, it should be sufficient to serve as a guide for students. Some possible issues of the different first-level associations. <u>Places</u>: It is easy for the students to start with places, and many objects are related to each place, allowing them to think of problems. However, some problems may not relate directly to SDGs. For example, school bags do not have sufficient compartments, and often, students take a lot of time to find the small items in the bag. This does		

not link to SDGs directly. We need to ask students what the connection to SDGs is. It could be that the bag design can consider the materials' sustainability.

Different groups of people: Students can relate easily to themselves. However, they may not know much about the problems faced by the elderly, people with special needs, etc. They can search on the internet to understand the problem. They need to be specific in their search to find more specific problems, such as problems faced by elderly people taking public transport or living alone.

SDGs sub-targets: Students will be focused, and the problem will be linked to the SDGs. However, the areas explored may not be wide.

Some students may have problems filling out the mind map. To solve this, they can start another first-level association. Also, sometimes, some problems come to mind that do not fit the first-level association, so you can branch out to another first-level association. Refer to Example 4.

References and Resources

1. Nelson, N. (10 February, 2023). *Concept and Mind Mapping*. Teaching and Learning Conestoga. Retrieved January 7, 2025, from <https://tlconestoga.ca/concept-and-mind-mapping/>.
2. Buzan, T. (2018). *Mind Map Mastery*. Watkins Media.

Think Deep with Questions

Purpose

Considerations and questions can provide students with a structure to think deeper about what they see daily, surfacing issues and drawing connections between related problems.

Content

Materials/ Equipment required

Time allocated

- How do you think about problems in the community with questions?
 - Students can think from the perspectives of the purpose of the place, facilities, objects, users, and how to achieve SDGs.
 - Refer to the guidebook for questions to guide them in thinking from different perspectives.
 - The A3 Community Sheet provides a visual reminder for students to observe their surroundings, be curious, and care for people to think deeper and uncover hidden problems.
 - The questions at the bottom of each scenario are examples to help students consider possible problems related to their community and the SDGs.
 - Students can paste the A3 Community Sheet on the page provided in the workbook.
- Students can complete the mind maps at home before the next lesson.
- When students have completed the mind maps, they can paste them on the page provided in the workbook.

Guidebook

A3 Community
Sheet

60

Facilitation Notes

- Students may not be used to wondering and asking questions to think deeper. The guiding questions in the guidebook and earlier reflection questions will help them start. Teachers can demonstrate how to use the questions to think about problems as they create the mind map with the class.
- Teachers can use some examples in the resources to highlight to students how these people think and have the heart to want to do something to improve their situations. Teachers may also use similar reflective questions and share some familiar examples with students, or they see daily to guide students in exploring problems. The students can refer to the 4 examples of mind maps.
- Students should be given ample time to explore problems. Teachers can encourage them to be more observant in their daily lives and take a greater interest in the people and environment around them.
- Teachers may want to take some photos in the neighborhood, the school, and events of daily life as examples for discussion on what they see in the photos and what questions they can ask from what they have observed.

References and Resources

1. Harvard Graduate School of Education. (n.d.). *See, Think, Wonder*. Project Zero. Retrieved January 7, 2025, from https://pz.harvard.edu/sites/default/files/See%20Think%20Wonder_3.pdf.
2. Harvard Graduate School of Education (2015). *Imagine If...* Project Zero. Retrieved January 7, 2025, from <https://pz.harvard.edu/sites/default/files/Imagine%20if.pdf>.
3. Hasso Plattner Institute of Design at Stanford University. (n.d.) *Ethnographic Field Guide*. Retrieved January 7, 2025, from <https://static1.squarespace.com/static/57c6b79629687fde090a0fdd/t/5d980bbeef5b5717b186539f/1570245598860/Ethnography+Fieldguide-DSS-Aug-2019-screen.pdf>.

Lesson 3: Selecting a Problem

Learning Objectives:

1. Students will be able to write problems clearly with details.
2. Students will be able to understand the importance of setting criteria to choose a problem.
3. Students will be able to understand and use the decision axis and decision matrix methods to choose a problem.
4. Students will be able to select a problem to work on as a group for the project.

Introduction to Selecting a Problem		
Purpose Students need to select a problem as a group. Given the many problems they have each identified, it may be difficult for them to decide. Two strategies are introduced to help them make logical decisions: Decision Axis and Decision Matrix.		
Content	Materials/ Equipment required	Time allocated
• Students have explored many problems and improvements that can be made in their community. • In this lesson, they will work in a team to evaluate problems and select one problem to tackle. • They will learn to write detailed problems, set criteria for selecting problems, and use the decision axis and decision matrix method to choose a problem.	Guidebook	5

Writing Problems with Details		
Purpose The mind maps created by the students are mainly made up of short phrases or words. Students need to write the problems in sentences to articulate their thinking and help others understand them. When the problem is written clearly, it will guide them in their research later. For example, the problem of expired raw meat can be faced in a supermarket or at home. However, the reasons for expired food, the amount of expired food, and how they deal with it differ in these two contexts. Also, the solutions applicable to supermarkets and homes may be different. Hence, students need to define the context to guide their research.		
Content	Materials/ Equipment required	Time allocated
• Before they can start working in their groups, students need to select five problems from their own mind maps and write them in detail so that others can understand. • Students write the 5 problems in the space provided in the workbook. They need to include the place where it happened, the people involved, what happened, how and why it happened. • Students can refer to the guidebook for examples.	Guidebook Workbook	15

Facilitation Notes

- At this point, students are writing out the problem based on their perspectives and perceptions. Their writing may be short, superficial, and not accurate, but that is okay. During the understanding problem stage, teachers need to guide students in determining what they need to research to understand the problem well.
- Also, some students may state what they want to do without explaining the problem clearly. For example, when designing an educational program for students, the students may know what they want to do, but they do not explain why they need to design it or the problem they are trying to address.
- Teachers may observe how the students write the problems and prompt them to write clearly when necessary.

Reference and Resource

1. Dalal, A. (15 May, 2021). How to Use Writing to Improve Your Thinking. *Medium*. Retrieved January 7, 2025, from <https://medium.com/curious/how-to-use-writing-to-improve-your-thinking-f9cd8c27c07e>.

Share Problems in Groups**Purpose**

Students take turns sharing their problems in their groups. This allows them to articulate their thinking and allows others to clarify what they have shared.

Content**Materials/
Equipment required****Time
allocated**

- Each student writes the 5 problems with keywords or short phrases on the Post-it. One problem, one post-it.
- Students shared the problems on the post-it with each other in the group.

Post-it

25

Markers

Facilitation Notes

- Teachers need to get students to write problems on Post-it quickly, as sharing more than 20 problems in the group will take time. If some students have completed writing the problems early, they can start writing them on Post-it.

Introduction to Evaluating Different Problems**Purpose**

We need good reasons to select a problem. The decision should not be based only on our feelings. Hence, we need to set criteria to evaluate all problems and select one problem. There are no right or wrong criteria. Every criterion is good. We need people to solve the different problems, as the SDGs are set out to be inclusive. The students need to decide what is more important to them as a group.

Content**Materials/
Equipment required****Time
allocated**

- Students need to decide on one problem to solve as a group. They need to decide the criteria to evaluate and select a problem.
- What are criteria, and why is setting criteria important to decide a problem?

Guidebook

15

Students will use two methods to decide on a problem – Decision Axis and Decision Matrix.		
Facilitation Notes Teachers can use daily life decisions to explain criteria to students. For example, they can explain how they choose what clothes to buy, what to eat, or what presents to buy for their friends. We have criteria when we make decisions every day.		

Decision Axis		
Purpose The group needs to decide which two criteria are their top priority. There are no correct answers to which criteria to choose. They can choose any of the two criteria which they deem important. The decision axis method will help them to eliminate problems that don't meet these criteria.		
Content	Materials/ Equipment required	Time allocated
- What is the purpose of the decision axis? - The group needs to choose two criteria that are most important to them from the list provided in the guidebook. - What is the meaning of each criterion on the list? The criteria “the number of people impacted” and “minority groups” are opposite criteria. Students should choose either one. - Each group will create the decision axis on the given big sheet of paper and marker. - Write the chosen two criteria at the end of the axis. - Evaluate each problem based on the two criteria and paste the post-it on the big sheet. Refer to the guidebook for instructions on the method. - After evaluating all problems, determine five problems high on both criteria. If problems are similar and related, they can be grouped as one problem.	Guidebook Workbook Big sheet of paper (Decision Axis Sheet, One per group) Markers	25
Facilitation Notes - Students can develop their own criteria for evaluating the problems. The list of criteria is provided because students working on real-world problems for the first time may be unsure of how to set the criteria. - Each group will evaluate more than 20 problems. Many problems may be placed around the same position. They can paste on top of or overlap part of it. - There may be more than five problems on the high side. The group has to decide on five problems. - Some problems may be very similar. For example, the context may be the same, but the reasons may be different and related. They can group them as one problem. If this problem is chosen later, they may need to edit it.		

Decision Matrix		
Purpose The decision matrix is to help the group evaluate further based on other criteria to decide on one problem.		
Content	Materials/ Equipment required	Time allocated
• Explain the purpose of the decision matrix. • Paste the five selected problems on the top row of the A3 Decision Matrix Sheet and list the remaining criteria from the <i>List of Criteria</i> in the left column. • Based on the five selected problems, each group evaluates their problems against the criteria. Pick a tick on the box if the problem meets the criteria. • Total up the number of ticks in the bottom row. The highest score problem will be the chosen problem. • If there is more than one problem with the same highest score, the group will decide which to choose. • All students write their chosen problem and the related SDGs in the workbook.	Guidebook Workbook A3 Decision Matrix Sheet (One for each group) Markers	15
Facilitation Notes • The group does not need to choose the highest-scoring problem. It is fine if they have a reason to choose the second-highest-scoring problem. Importantly, they can explain their reason clearly and logically. • Teachers may want to take note of each group's chosen problem to prepare for the next lesson.		

Lesson 4: Understanding the Problem

Learning Objectives:

1. Students will be able to understand that the problems they see and think about might be based on their assumptions, not real situations.
2. Students will be able to understand that they need to research to find accurate information and listen to the perspectives of the people involved to understand the problems.
3. Students will be able to understand that a good understanding of the problem is the key to achieving good solutions.
4. Students will be able to craft a good research plan to understand the problem.
5. Students will be able to understand the differences between conducting a survey and an interview.
6. Students will be able to understand how to craft surveys and interview questions.
7. Students will be able to understand how to research for accurate, reliable, unbiased, and fair information.

Introduction to Understanding the Problem		
Purpose Very often, the problems written by the students are superficial, and they see issues only from the surface or from their perspectives. This lesson teaches students to research to justify what they see and think, to understand the problem accurately, and to nurture their critical thinking.		
Content	Materials/ Equipment required	Time allocated
• The problems we see are usually based on our assumptions, not the real situation. • Students need to understand the terms - assumptions, accuracy, biases, fairness, perspectives, and evidence. • In the first part of the lesson, students will examine whether the problem they have written is accurate and unbiased. • In the second part of the lesson, students will learn how to understand the problem by researching accurate information. • Students will learn what and how to research and craft a research plan. • A good understanding of the problem is the key to achieving a good solution.	Guidebook	10
Facilitation Notes • It is important to introduce the terms - assumptions, accuracy, biases, fairness, perspectives, and evidence with examples that students can relate to. This will help students reflect on how they make judgments in their everyday lives and how easily they are influenced by others without thinking deeper or knowing more. • Understanding the problem is very important and key to achieving good solutions. It is important to explain this point with an example of the real world that the solution does not solve the problem.		
Reference and Resource 1. Loh, W. L. (2020). Sharpening Critical Thinking in Problem Identification in Design and Technology Education. In <i>Proceedings of DRS 2020: Synergy</i> (Vol. 2, pp. 899). Design Research Society. https://doi.org/doi:10.21606/drs.2020.358.		

Verification of Problem through Group Assessment		
Purpose: This activity intends for students to realize that the problem they have written may not be accurate and that they may not understand it. This activity will lead to the next part of the lesson, which is for students to understand what they need to find out and how to do it to understand and justify the problem.		
Content	Materials/ Equipment required	Time allocated
- Students are given a table in their workbook with a list of questions to assess whether the problem they chose is accurate. - They discuss the questions and answers in their workbook by ticking a “Yes” or “No”.	Workbook	5

Understanding the problem		
Purpose Students need to understand that they have to research to find accurate information and listen to the perspectives of the people involved to understand the problem accurately.		
Content	Materials/ Equipment required	Time allocated
- To understand a problem, students need to research for accurate information as evidence to justify the problem. - Students need to conduct surveys or interview relevant people to understand the situation. - Students may need to conduct a site visit to observe and record the situation or the user. - Students need to look at current situations to understand what has been done and evaluate the effectiveness of the solutions, as well as the advantages and disadvantages. The more they know, the more they will open their minds and help them during the ideation stage. - Using the four examples of research plans provided in the guidebook, explain to students what evidence they need to collect, how to find the evidence, which they need to seek an opinion from to make a fair judgment, and the currently available solutions.	Guidebook	20
Facilitation Notes - Teachers can use the four examples of research plans in the guidebook to help students understand what information and data they need to research to understand problems and how to research them. - The four examples of the research plans showed different scales of the problems and their implications and how teachers need to guide students in scoping the problems.		

Research Plan		
Purpose: Based on what they have learned, students need to draft a research plan to identify what evidence they need to look for to justify their chosen problems.		
Content	Materials/ Equipment required	Time allocated
- Based on what the students have learned, they discuss in their groups the evidence they need to collect, how they will collect it, who they need to seek an opinion from, and how to do it on the table of the A3 Research Plan worksheet. - After discussion, students need to examine the evidence they want to collect to see if they can combine duplicates or similar areas. They may also need to organize it. - Then, everyone notes down the finalized research plan in their workbook. - Students discussed the work allocation and noted it in the workbook.	A3 Research Plan Worksheet (One per group) Workbook	30
Facilitation Notes - To facilitate the group discussions, teachers may want to consider the evidence that each group needs to collect before the start of this lesson. This will help teachers to guide groups that are unsure or lack areas that they need to research through questioning during the lesson. - The problem chosen by the students may be too big for them to handle. Teachers may need to help students scope the scale of the project later after they have done some research. - Teachers may want to check that each group's work allocation is reasonable.		

How to conduct accurate and reliable research?		
Purpose: This is to educate students on how to conduct accurate and unbiased research.		
Content	Materials/ Equipment required	Time allocated
Students need to take note of the following when conducting research. - Cite the source of information to give credit to the source and as evidence. - Choose reliable sources for accurate information. - Find information from more than one source to justify the accuracy of information. - Find information from relevant people to provide accurate information. - Find information from more than one person to ensure the information provided is not biased and representative of the target group.	Guidebook	10
Facilitation Notes Teachers may want to bring up the topic of generative AI. It is a good tool, but it has its limitations, and students need to verify the sources of information provided by the tool.		

- It is also important to highlight to students that research via the Internet is not sufficient. It is important to talk to people and experience the situation because they are the people for whom they want to solve the problem. Their views matter, and they need to be skillful in asking questions, which will be discussed in the next part.

Survey and Interview

Purpose

Students understand the purpose of surveys and interviews to use the correct methods for their research. They know how to craft good questions for a survey and an interview and conduct an e-survey.

Content

Materials/ Equipment required

Time allocated

- Introduce survey and interview. Students can refer to the guidebook.
- Explain about survey.
 - How to design good survey questions?
 - What question formats are there?
 - What is the advantage of e-survey?
- Explain about the interview.
 - How to prepare for the interviews?
- What other things should be noted when conducting surveys and interviews?

Guidebook

25

Facilitation Notes

- It is important to provide feedback to the questions that the students have designed by asking them questions to lead them to reflect on how their questions can help them achieve the objectives and if their questions can lead them to answers that they hope to achieve.
- It is good to encourage students to do a test survey with someone who does not know what they are doing. It is more convincing and tangible for students to understand the effectiveness of their questions.
- If teachers think there is insufficient time to teach survey and interview skills, they can teach it in the next lesson.

References and Resources

1. QuestionPro. (2024). *Close Ended Questions*. Retrieved January 7, 2025, from <https://www.questionpro.com/close-ended-questions.html>.
2. Ruel E. (2019). *100 Questions (and Answers) About Survey Research*. Sage.
3. The Open University. (2024). *Conducting an interview*. Retrieved January 7, 2025, from <https://help.open.ac.uk/postgraduate-study-skills/conducting-an-interview>.
4. Virginia Polytechnic Institute and State University. (2023). *Research Methods Guide: Interview Research*. Retrieved January 7, 2025, from <https://guides.lib.vt.edu/researchmethods/interviews>.

Lesson 5 and 6: Research through the Internet, Site Visit, Surveys, and Interviews

Learning Objectives:

1. Students will be able to find accurate and relevant information through various means, such as the Internet, site visits, surveys, and interviews.
2. Students will be able to design surveys or interview questions relevant to gathering information to understand the problem.
3. Students will be able to document the key findings from the different sources.
4. Students will be able to conduct surveys and interviews with relevant people.

Research through the Internet, Surveys and Interviews		
Purpose Students will use the time to prepare and conduct research relevant to their problems. This lesson will require teachers to facilitate learning among the groups.		
Content	Materials/ Equipment required	Time allocated
<u>Introduction</u> • Students will use the time to research, create the survey and interview questions, plan the field visits, and conduct the surveys and interviews, depending on their agreed work allocation. • Students need to document their research by citing the sources and noting the key findings. At the end of the research process, they should print and paste the documents into their workbooks. • Why is it necessary to document research?	Guidebook	10
<u>Research on Internet</u> • Students who research information on the Internet can document their findings on their personal learning devices using a Word document or any other app. They can copy the link to the sources and type/cut and paste the key findings. They can also screenshot and paste important information or pictures into the document.	Personal learning device WiFi	90 + 100 (Lesson 6)
<u>Research on Site Visits</u> • Students who need to conduct field visits may need to make an appointment to visit the site. They need to know what and who they want to observe and how they want to record the observation. They may need to seek permission to record the observation.	Personal learning device WiFi	
<u>Research by survey and interview</u> • For students who are crafting the survey or interview questions should type out the survey and interview questions for easy distribution. • After they have finalized the survey form and interview questions, they need to print out the survey and interview and paste them into their workbook as a record.	Guidebook Personal learning device WiFi	

Students should set clear objectives for the survey and interview questions. They need to constantly check their questions against the objectives and predict the answers to see if they are what they are looking for. They should also do a trial test with other groups or anyone who doesn't know their research.		
Facilitation Notes This lesson needs teachers to facilitate the student's learning by providing feedback but not answers to help them uncover what is lacking in their research, what they need to do, the implications of their decisions, etc. It is often done through questions. If students are left on their own without any feedback, there is a chance that their research may not be deep, and they may not understand the situation. It will lead to ideas that cannot solve the problem. <u>Research on Internet</u> - Some students may be unable to find the information they need online. Teachers can suggest students use different keywords or rephrase questions to search for information. Also, some students may not be familiar with the government and municipal offices. Teachers can introduce relevant organizations to them. - It is important that students research well. If they have done comprehensive research, it will help them generate good ideas later. Teachers should give feedback to students in the class if the research is insufficient or going in the wrong direction. - Teachers may want to consider the different group projects and briefly search the Internet before class. This will help them guide students who are stuck or going in the wrong direction. <u>Research by site visits</u> - Students may need to make appointments for the site visits and seek permission to record the observation of places or people. In this case, they may need to be supported by the school for the request. Teachers may need to advise the students according to the school protocol. <u>Research by survey and interview</u> - As the students develop the questions, teachers may want to provide feedback to ensure that the questions are relevant to the survey's objectives, easy to understand from the interviewees' perspectives, organized logically, etc. - Students may refer to the guidebook or the internet for references when setting the questions. - Students who conduct interviews should be ready to probe further and clarify the points if the interviewees' answers are unclear. They can refer to the guidebook for the type of questions to ask during the interview. - Schools may have different protocols for data collection. Teachers need to consider the protocols and think through the following as students craft the survey and interview questions. - If the survey and interview targets are in the school, how can the students conduct the survey or interview? Is it during class time or outside class time? Do teachers need to make any arrangements? - If the students use an e-survey, how can they distribute the survey? - If the survey and interview targets are outside school, the students may have to conduct the interviews outside school hours. Is anything procedure needed, and what else do students need to take note of?		

Lesson 7: Analyze Information and Data

Learning Objectives:

1. Students will be able to organize the information and data that they have collected.
2. Students will be able to interpret the information and data accurately and draw conclusions on their findings.

Analyze Information and Data		
Purpose Students used the guided questions in their workbook to help them analyze the information and data they had collected.		
Content	Materials/ Equipment required	Time allocated
• Students will analyze the data and information collected. • Students need to first organize the information by categorizing it and writing it in the workbook. • Students analyzing surveys may want to present the statistics data using graphs and charts for easy understanding. • Students need to interpret the information and data and construct explanations. To do this, they can use the following questions to analyze. - Explain what happened. - Why is this happening? - What is the implication? • Students write down their analysis in their workbooks.	Personal learning device WiFi Guidebook Workbook	100
Facilitation Notes • Teachers can examine students' writing. If it is superficial, unclear, or unconvincing, teachers can ask questions such as the following to encourage them to think deeply about it. - What do you mean by this? - What's the connection? - Where did you find this evidence? - Is there a pattern? • If students cannot provide a good reason for their findings, they may need to continue searching the Internet for answers.		

Lesson 8: Consolidate Findings and Finalized Problem Statement

Learning Objectives:

1. Students will be able to analyze the information gathered from various sources in their groups.
2. Students will be able to draw conclusions accurately and summarize their findings.
3. Students will be able to rewrite the problem clearly and accurately.

Recap and Consolidate findings and Finalized Problem Statement		
Purpose Students need to consolidate all the findings they have collected as a group to help them understand the problem accurately and rewrite the problem statement.		
Content	Materials/ Equipment required	Time allocated
• Students will share with each other what they have found out. From the information and data collected, they will determine whether what they found was congruent. If not, they will try to determine the reasons and find the root cause and core of the problem. They will note down their discussions in their workbooks. • Students summarized their findings in their workbooks independently. They needed to explain their findings in sentences and paragraphs to express them logically. • Students discussed how to rewrite their problems clearly and accurately based on their findings. They need to include the place where it happened, the people involved, what happened, how, and why it happened. They can write the problems on the big sheet of paper provided. They can refer to the guidebook for examples. • After students have finalized the problem, they can note it in their workbooks. • Students also need to note down the related SDGs in the workbook.	- Personal learning device - WiFi - Workbook - Big sheet of paper (Problem Statement Sheet, One per group) - Markers	100
Facilitation Notes • Students should note their findings in their workbooks as they discuss them. Teachers can encourage students to question each other's findings rather than just accept what they say. They also need to ensure that the information and analysis are accurate. • Teachers can join the groups for a short while to listen to the discussion or read what they have written, question their findings, and try to lead them to think about the root cause and the core of the problem. • When students summarize their findings in the workbook, they should write them in proper sentences and paragraphs. Writing them out individually will help them think through and reason their arguments. • Similarly, when students discuss and write their problem statements, teachers can give feedback if there is missing information or if some parts are unclear. Teachers can ask questions such as, - What do you mean by this? - Do you mean....? - Can you explain in more detail?		

Lesson 9: Generating Ideas

Learning Objectives:

1. Students will be able to come up with “How-Might-We” questions to guide them in generating ideas.
2. Students will be able to generate innovative and feasible ideas to solve problems.

Introduction to Generating Ideas		
Purpose Students need to generate many innovative and feasible ideas. To help them explore ideas, a strategy called “How-Might-We” questions will be used.		
Content	Materials/ Equipment required	Time allocated
• This lesson focuses on the ideation stage. In the first part, students generate ideas by asking “How-Might-We” questions based on their problem statement and summarized research findings. • In the second part of the lesson, students will generate innovative and feasible ideas to solve the problems.		5

“How-Might-We”		
Purpose Ideation can be daunting for students who are unfamiliar with it. “How-Might-We” questions can turn problems into opportunities for design. They will help you break down your problem into smaller parts to generate solutions.		
Content	Materials/ Equipment required	Time allocated
• There are many ideation methods, and one method that the students will learn is “How-Might-We” questions. • The “How-Might-We” questions can turn the problem into opportunities for design. Students can refer to the guidebook for examples. • Students discussed in their groups, generated “How-Might-We” questions based on their problem statement, and summarized research findings on the given big sheet of paper. • There is no limit to the number of questions. The more questions, the more ideas they can have. However, if there are too many, they should examine if there are overlapping questions and see if they can be combined. • The group needs to number the questions. • After the group has finalized the questions, each student records the questions in the space provided in their workbook.	Guidebook Big sheet of paper (HMW Questions Sheet, 1 per group) Markers Workbook	25

Facilitation Notes

- If the groups cannot generate the questions, teachers can ask them to review their summarized findings and consider how they can turn the findings into questions.
- Teachers may want to think through the “How-Might-We” questions for each group before the class to understand the possible difficulties that their students may face.
- There are many other ideation methods that teachers can explore in conjunction with “How-Might-We” questions, such as SCAMPER, storyboarding, journey mapping, etc. Some of these methods are generic and suitable for all types of problems, but some are more effective for certain types of problem solutions. Teachers may want to read more about it and introduce them to the students.

References and Resources

1. Anderson-Stanier, N. (n.d.). *How Might We Statements: A Powerful Way to Turn Insights into Opportunities*. Dscout. Retrieved January 7, 2025, from <https://dscout.com/people-nerds/how-might-we-statements>.
2. IDEO. (n.d.). *How Might We*. Retrieved January 7, 2025, from <https://www.designkit.org/methods/how-might-we.html>.

Generating Ideas**Purpose**

Students generate many different ideas based on the “How Might We” questions.

Content**Materials/
Equipment required****Time
allocated**

- Students brainstorm as many different ideas as possible based on the questions individually.
- At this stage, the students can come up with wild ideas. They may not know the technology or have the skills to create the idea, but it is acceptable if they can provide evidence that the idea is feasible. For example, if they suggest applying a certain technology to the idea and this technology has been invented or currently researched by experts.
- It is important to highlight to the students that they can adapt to the ideas that they have researched. However, they cannot copy them entirely. They need to make some changes to improve it. Otherwise, it is plagiarism.
- The students record their ideas with some details to explain how the idea works in words and/or sketches in the space given in the workbook.
- They can research on the internet to draw inspiration.
- Students need to complete the ideation before the next lesson.

Student Workbook

70

Personal learning
device

WiFi

Facilitation Notes

As students generate ideas, teachers may look at the ideas generated by students and give them feedback. For example,

- If the idea is too vague, the teacher can ask them to explain in more detail how it works.
- If the idea is too wild, abstract, and unrealistic, teachers can ask students to research whether the current

technology supports its feasibility. This will signal to students that we are looking for ideas that are possible to work with. However, far-fetched ideas are not all bad ideas. To a certain extent, they inspire researchers to explore and think of ways to achieve the idea. It needs time, expertise, and resources. In the context of this project, students may not have the time to explore and create a solution that can be invented in time.

- If the idea is the same or almost the same as the existing solution, the teacher can ask the students to change or improve part of the solution to make it unique.

In nurturing creative thinking, we want to encourage students to generate ideas as follows:

- Many different ideas and ways of doing things. To do so, reading widely and exposure to different case studies/solutions can help to widen their thinking.
- Feasible ideas. The ideas cannot be farfetched in solving real-world problems. They need to have some degree of plausible implementation. The ideas should be accompanied by annotation, explanations, research evidence to support the workability of the idea, etc.
- Improving existing ideas. New ideas can also come from improving existing solutions creatively to make them more effective and efficient.

Reference and Resource

1. OECD (2024). *PISA 2022 Results (Volume III): Creative Minds, Creative Schools*, PISA, OECD Publishing, Paris, <https://doi.org/10.1787/765ee8c2-en>.

Lesson 10: Selecting an Idea

Learning Objectives:

1. Students will be able to explain their ideas clearly to their group members.
2. Students will be able to build on each other's ideas and give constructive feedback to improve their ideas.
3. Students will be able to choose an idea in their group to develop the concept.

Introduction to Selecting an Idea		
Purpose Students need to select an idea from the many ideas generated in the group using the decision axis method.		
Content	Materials/ Equipment required	Time allocated
• In this lesson, students will decide on an idea to develop the concept within their group. • In the first part of the lesson, they will share their ideas with their groups. • In the second part of the lesson, the group will evaluate all the ideas and decide on an idea to develop the concept.		5

Sharing ideas		
Purpose Sharing ideas will open the students' minds, and it may trigger them to build on each other's ideas to come up with better or improved ones. Asking students to evaluate the advantages and disadvantages of the ideas will help them decide on one later.		
Content	Materials/ Equipment required	Time allocated
• Students note down the keywords of each idea on one Post-it. • Students share their ideas with their group members. They can start by indicating which idea is associated with which "How-Might-We" question. • The Post-it can be organized according to the "How-Might-We" questions and pasted on the previous lesson's big sheet with the questions. • If the idea solves a few questions, it can be pasted on the table or elsewhere. • Students are encouraged to build on each other's ideas to strengthen the idea or to give constructive feedback on the ideas shared. • They can discuss the advantages and disadvantages of each idea and note them down on Post-it. • After the group has shared, they can group similar ideas for each question.	The previous lesson's HMW Questions Sheet Post-it Markers	55

If ideas are similar across the questions, they can group them by pasting the Post-it together.		
Facilitation Notes - Teachers can walk around to hear the ideas and prompt students to explain more if it is unclear or for the group members to give suggestions or feedback. For example, - What do you think of this idea? - Do you have any suggestions for improving this idea? - How can we make this part better? - Teachers can demonstrate what it means to build on each other's ideas by suggesting improvements to students' ideas or combining two of their ideas. - Teachers need to monitor the time and get students to move faster if they take too much time. - If the group size is smaller or has fewer ideas, they may finish faster. In this case, teachers may ask the group to prepare for the next activity.		

Selecting an idea		
Purpose: Students need to select an idea using the decision axis method with two criteria – Originality and Feasibility.		
Content	Materials/ Equipment required	Time allocated
- To choose an idea, we need to decide on the criteria. In general, students can use the decision axis method, or if they have many criteria, they can use the decision matrix to decide which idea to select. - However, in this project, they can evaluate the ideas based on two criteria: originality and feasibility. - What do originality and feasibility mean? - Students can draw two axes, like a cross, on the big paper provided. - Label the horizontal axis with "Ordinary" on the left and "Original" on the right. Then, label the vertical axis with "Feasible" on top and "Not Feasible" on bottom. - Students can evaluate each idea based on these two criteria and place the Post-it on the big paper. - They can review the ideas pasted on the quadrant of "Original" and "Feasible" high on both criteria to decide which idea to choose. It is possible to combine two or more of the ideas and choose the idea. - Students record the selected idea in their workbook.	Big sheet of paper (Axis Frame Sheet, 1 per group) Markers Workbook	40
Facilitation Notes - Teachers need to remind students that the idea can be considered feasible even if they lack the expertise to realize it at this point, but they need to support it with evidence that it is possible. - If there is still some time, teachers can introduce the topic of developing the concept for the following week.		

Lesson 11: Creating Concepts

Learning Objectives:

1. Students will be able to understand what is expected in the design concept.
2. Students will be able to create a design concept.

Design Concept		
Purpose An idea is usually very brief. A design concept will get students to think about the considerations and details needed for the idea to work. Different idea outcomes will require different considerations. The four examples in the guidebook will provide considerations for the different types of outcomes: app design, space design, competition, and product design.		
Content	Materials/ Equipment required	Time allocated
• What is a design concept? • How to develop a design concept?	Guidebook	20

Developing Design Concept		
Purpose Students discuss the considerations needed for their chosen ideas in the form of questions and use them to guide them in developing their ideas.		
Content	Materials/ Equipment required	Time allocated
• Students discuss how to improve their selected idea (if there was any feedback on it during the previous lesson). • After that, they can discuss and list the considerations in the form of questions for their concept in the workbook. • When they finalize the considerations, they can discuss the answers to the questions and note down the design concept in words and sketches in the workbook. • They can also discuss and sketch on the big paper provided and note down their discussions in their workbook later. • Along the way, they can research online to look for information and inspiration to develop the concept. • Students can continue developing the concept in the next lesson.	Workbook Big sheet of paper (Design Concept Sheet, 1 per group) Markers Personal learning device	80
Facilitation Notes • Teachers can move around to listen to the group discussions and provide advice. • If some groups lack consideration, teachers may lead them to think about it. For example, if the group forgot about a stakeholder, the teacher may prompt them, "What happened at this stage? Who else should be involved? Did we miss out on someone?"		

- If some groups are still determining what else they need to consider, they can search on the internet. For example, if their idea is to develop an educational ecotour, they can search “What to include in an educational ecotour? How do you plan an exciting educational ecotour?”
- Teachers may want to think through the considerations for each group before the class so that it is easier to facilitate during class.

Lesson 12: Creating Concepts and Prototyping

Learning Objectives:

1. Students will be able to understand what prototypes are.
2. Students will understand the types of prototypes used to present different concepts.
3. Students will be able to select appropriate prototypes to test their design concepts.

Continue Design Concept		
Purpose: Students used the time to finalize the design concept.		
Content	Materials/ Equipment required	Time allocated
• Continue developing design concepts.	Workbook Big paper (1 per group) Markers Personal learning device	55
Facilitation Notes • As different groups progress at different speeds, teachers can start introducing prototyping if one group has completed developing the design concept. After that, students can continue with the design concept or start to plan for the prototype-making.		

Introduction to Prototyping		
Purpose Making prototypes is necessary to test the concept's workability and ensure the solution works smoothly and effectively.		
Content	Materials/ Equipment required	Time allocated
• What is prototyping? • What are the types of prototypes?	Guidebook	15
Reference and Resource 1. Osa, S.S., & Liem A. (2014). Classifying Physical Models and Prototypes in the Design Process: A Study on the Economical and Usability Impact of Adopting Models and Prototypes in the Design Process. In <i>Proceedings of the DESIGN 2014 13th International Design Conference</i> (pp. 2071 – 2082). The Design Society. https://www.designsociety.org/publication/35348/CLASSIFYING+PHYSICAL+MODELS+AND+PROTOTYPES+I+N+THE+DESIGN+PROCESS%3A+A+STUDY+ON+THE+ECONOMICAL+AND+USABILITY+IMPACT+OF+ADOPTIN		

G+MODELS+AND+PROTOTYPES+IN+THE+DESIGN+PROCESS

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3. Indeed. (11 March, 2023). *10 Types of Prototypes (With Explanations and Tips)*. Retrieved January 7, 2025, from <https://www.indeed.com/career-advice/career-development/types-of-prototyping>.
4. Singh, L. (9 August, 2023). *14 Types of Prototypes in Product Design [Purpose & Examples]*. RedBlink. Retrieved January 7, 2025, from <https://redblink.com/types-of-prototypes/>

Planning Prototypes

Purpose

Students need to think about the prototypes they need to test their concept and its purpose. They may have to make more than one prototype.

Content

Materials/ Equipment required

Time allocated

- What is the purpose of your prototype?
- What kind of prototypes should you make?
- How do you make the prototypes?
- What materials or equipment do you need?
- Work allocation, including purchasing and materials/equipment/special facilities needed to make the prototypes.

Guidebook

30

Workbook

Facilitation Notes

- Teachers may need to prepare some materials for the students to make the prototypes the following week. It is good for the teachers to take note of the group's prototypes and work allocation.
- Depending on the scale of the concept, if more than 2 weeks are needed to make the prototypes, teachers can ask students to start creating them at home from this lesson onwards.
- If students create prototypes requiring special facilities such as the kitchen, science or computer laboratory, teachers may need to make the necessary arrangements depending on the school procedures.

Lesson 13 and 14: Prototyping and Evaluation

Learning Objectives:

1. Students will be able to create appropriate prototypes.
2. Students will be able to test their design concepts and receive feedback for improvement.
3. Students will be able to understand how to give constructive feedback.

Making Prototypes		
Purpose Students used the time to create the prototypes.		
Content	Materials/ Equipment required	Time allocated
• Making prototypes • As students create the prototypes, they may notice problems or issues with the prototypes. They can create an improved version before seeking feedback from others. They can sketch or take photos and print them out, then record the issues in the workbook.	As required by the groups	100 + 50 (Lesson 14)
Facilitation Notes • If the prototypes require much more time, teachers may advise students to complete as much as possible before the next lesson. The second half of the next lesson will gather feedback for improvement. • If there are groups that are faster in making the prototypes, teachers can teach the class how to give feedback. After that, those who have not completed prototypes can continue, and the rest can proceed to evaluate their prototypes. However, in this case, teachers can want to allow students to be free and easily approach their classmates or target group to test their prototypes.		

Evaluating Prototypes		
Purpose Students and invited guests (if any) test the prototypes and give feedback on improving them. Students need to understand how to give constructive feedback to encourage and help the students receiving it improve. Vague or hurtful feedback can diminish students' confidence in presenting and seeking feedback in the future.		
Content	Materials/ Equipment required	Time allocated
• How do you give constructive feedback? • Presenting prototypes and gathering feedback. - Feedback can be verbal or written on Post-it. - Students need to record the feedback in their workbook.	Guidebook Workbook	50

Facilitation Notes

- The evaluation can be done in a casual setting. The class can split into 2 groups, with 1 group presenting at their booths and the other group and guests going around to listen and give feedback within a stipulated time. Then, the group can change over. Alternatively, it can be free and easy for the class. At any time, 2 members will be at the booth to collect feedback. The rest can provide feedback for other groups.
- Teachers need to establish a safe environment for feedback by teaching students how to give encouraging and constructive feedback. This will allow students to voice their thoughts confidently and learn from each other.

References and Resources

1. Harvard Graduate School of Education & Opal School. (2019). *Gallery Walk*. Project Zero. Retrieved January 7, 2025, from <https://pz.harvard.edu/sites/default/files/Gallery-Walk.pdf>.
2. Tutt, P. (8 October, 2021). *Teaching Kids to Give and Receive Quality Peer Feedback*. Edutopia. Retrieved January 7, 2025, from <https://www.edutopia.org/article/teaching-kids-give-and-receive-quality-peer-feedback/>.

Lesson 15 and 16: Preparation for the Presentation

Learning Objectives:

1. Students will be able to understand the requirements for the presentation.
2. Students will be able to improve their prototypes based on the feedback gathered.
3. Students will be able to understand the factors to consider in preparing an effective presentation.

Briefing and Preparation for the Presentation		
Purpose Students understand the requirements for the presentation, the factors to consider when preparing an effective presentation, and how to utilize each other's strengths to prepare for the presentation.		
Content	Materials/ Equipment required	Time allocated
• Overview of the presentation and requirements. • How to prepare for an effective presentation? • Students discuss the presentation and work allocation, including making prototypes based on the feedback gathered in the last lesson. • Students can discuss how to split the work among themselves and note down work allocation in the workbook.	Guidebook Workbook	100 + 100 (Lesson 16)
Facilitation Notes • Teachers may want to consider the following for the presentation requirements. - Name for the concept - Form of presentation, presentation board or digital presentation, etc. - Formal presentation or presentation booth - In the case of a formal presentation, the duration of the presentation and Q&A (if any). - In the case of the presentation board, the size and number of boards. - Who will be the guests? - Content required such as problem statement, design concept with sketches and description, prototypes, etc. • Teachers could invite users and stakeholders to view and give feedback to provide authentic learning experiences. • Depending on the type of design concept, students may or may not be able to create a prototype within the time limit and the availability of the technology and equipment in school. For example, if students produce a food product, poster, brochure, competition, program, or simple small product, they can likely create prototypes. However, students working on architectural models, apps, or products may not have the skills and technology to make prototypes. In this case, students may make prototypes or models that show an overview of the concept and are supported with prototypes that demonstrate the various functions of the concept, such as scaled-down models. etc. It is up to the teacher's discretion, depending on the school's capability and time constraints.		

Lesson 17: Presentation

Learning Objective:

1. Students will be able to select and use appropriate mediums to communicate their concepts.
2. Students will be able to communicate their concepts clearly and convincingly to the invited guests.

Presentation		
Purpose The presentation allows students to articulate their design concepts using various mediums to explain to real users and stakeholders, allowing them to gain authentic learning experiences.		
Content	Materials/ Equipment required	Time allocated
• Presentation and Q&A. • Students record feedback and comments in their workbooks.	Workbook	100

Lesson 18: Reflection and Closure of Project

Learning Objectives:

1. Students will be able to reflect on their learning journey and experiences in this project.
2. Students will be encouraged and inspired to do good for their community.

Reflection		
Purpose Students reflect on their learning journey and experiences of the project and, based on that, how they can take action with their understanding moving forward.		
Content	Materials/ Equipment required	Time allocated
• The importance of reflection • Students reflect on learning journeys and experiences in their workbooks based on guided questions.	Workbook	50
Facilitation Notes • Reflection is an important process for students to think about what they have learned, how it has helped them, how they can do it better, how what they have done has helped others, and what they can do with their learning in the future. It is a process of constantly bettering themselves. In the context of this project, we hope that they can understand the importance of taking action to help their community, fostering compassion and a sense of purpose, and, henceforth, willingly, in their own capacity, be change-makers, contribute to society by solving real-world problems in small and big ways.		
Reference and Resource 1. University of Connecticut. (n.d.). <i>Reflective Models</i>. Retrieved January 7, 2025, from https://edtech.uconn.edu/multimedia-consultation/portfolios/reflection-models/.		

Sharing of Thoughts and Closure of Project		
Purpose Students share their thoughts to inspire and encourage them to continue to be changemakers as individuals or as a class. Teachers can use these opportunities to establish a culture of caring and action for their community.		
Content	Materials/ Equipment required	Time allocated
• Students share their thoughts. • Teachers end with closing thoughts and how they could move forward as a class and as individuals to achieve SDGs.		50
Facilitation Notes • Teachers can seize the moment to inspire and encourage them to be changemakers and establish a culture of caring and action for their community. • Teachers can encourage students to continue asking questions such as, “What if?”, “What problems do people experience?”, “What might be created to solve those problems?”, etc., and thinking of the answers.		

- Teachers can also encourage students to ask big questions such as, “How might nurturing our relationship with our community support our understanding of people and grow our abilities to think and act creatively and collaboratively for the good of everyone?”, “What becomes possible when we share our strengths with our community?”, “How will the world change if everyone plays a part in solving a real-world problem?” etc.
- If students constantly think about these questions, it will foster compassion for people and the heart to make a difference, and hopefully, eventually, students will be changemakers.

Reference and Resource

1. Harvard Graduate School of Education & Opal School. (n.d.). *Asking Big Questions*. Project Zero. Retrieved January 7, 2025, from <https://pz.harvard.edu/sites/default/files/Asking-Big-Questions.pdf>.