

Rubric for Essay Evaluation

November 16, 2023

The workshop course is provided by technology-oriented engineering department. The goal is to understand technologies but also to foster motivation and active involvement of groupwork. The assignment given to the students was as follows:

1. Kinematic Synthesis of Mechanisms <Train Gap Filler>

The gap between the train and the platform at train stations is a significant safety hazard, often leading to accidents. This risk is especially high for children, the elderly, and individuals with physical disabilities with wheelchairs. The challenge is to devise a mechanism that effectively mitigates this danger.

2. Kinematic Synthesis of Mechanisms <Say “NO” to Door Knobs>

This project develops a new mechanism for touchless doors, inspired by the widespread unease with touching door handles in public spaces like schools, hospitals, and restrooms during the Covid-19 pandemic. This design aims to eliminate the need for physical contact with door knobs.

3. Net Zero X <Carbon Dioxide Removal>

Given that emissions of CO₂ are produced by all sectors of society, identifying effective ways to capture CO₂ and store it safely is crucial. Create methods to extract CO₂ from the air and separate it into its constituent elements, carbon and oxygen, and explore how these elements can be repurposed effectively.

4. Net Zero X <All Electric Airplane>

The objective of this project is to develop a strategy for reducing CO₂ emissions from airplanes. It involves researching the current challenges faced by the airline industry regarding CO₂ emissions and conceptualizing an all-electric airplane as a viable solution to significantly lower these emissions.

5. Radioactive <Science Communication on High-Level Radioactive Waste>

High-level radioactive waste (HLW) is created by the reprocessing of spent nuclear fuel. Storage cannot provide the permanent isolation of the wastes from human's environment. This workshop aims

to reveal the current conditions and possible disposal methods of HLW, and understand ways of dealing with real social issues.

6. Monster Track <Damages on Infrastructures by Oversized Vehicles>

The oversized loading induced an excessive external load which exceeds load-carrying capacity of bridges, resulted in collapse incidents. Clarify the common challenges in protection of infrastructures during their life cycle from oversized vehicles and come up with initiatives and solutions to this issue.

Around six students formed groups and challenged one of the above six problems in seven 3-hour workshops: ideation, interim report, prototyping, final report, and a reflection essay at the end. Each student is requested to create an individual reflection essay including the following descriptions.

- Project description (300-400 words)

Title, goal and conclusion of the project

Process of the project: how you applied design thinking methods

- Contribution (300-400 words)

Your role in the project

Your contribution to the project

- Reflection (200-300 words)

Write freely but we are interested in what you learned from the series of workshops not only professional knowledge and skills but also how to contribute to and facilitate the workshops

Here is a student essay to be evaluated.

[STUDENT ESSAY]

I was in the Net-Zero transportation group and our project was based on the reduction of the CO₂. We mainly focused on the aircraft industry. The rate of emission of CO₂ in the total global CO₂ emission is small comparing to other industries. However, this is because aircraft travels around the world, and the international emission is not included in each country's emission. Therefore, it is important for the airplane industry to work to solve the problem of the emission of the CO₂.

To solve the problem, we focused on introducing the electric airplane in normal flights. Electric airplane uses only electricity to fly. If we have enough electricity to use for normal flights, the emission of the CO₂ from aviation is said to be reduced by 87%. However, there are many problems that stops the electric airplane to be normalized. In our project, we pointed out some of the most important problems and tackled them. The problems that we investigated were battery efficiency,

weight of the battery and the charging electricity. To tackle the problems, we divided the problems into three big sections, which are science, charging and cost.

In the science section, we compared two types of batteries which are lithium-ion battery and solid-state battery. Lithium-ion battery is a common battery that is being used in our society like the electric cars. Solid-state battery is a battery that has many advantages. Since they don't use liquid, we do not have to worry for leakage during flights. Adding to this, the charging is faster for solid-state battery than Lithium-ion.

In the charging section, we mainly focused on the way of recharging the plane. We considered to recharge the electric plane during the flight since charging a battery from an empty battery is hard. Adding to this, we tried to work on with where we are going to afford all the electricity.

In the last section, cost, we lastly combined our ideas and summarize the cost that it will totally take to create and use all-electric plane. We considered the amount of cost we can offer the airplane ticket due to the maintenance, electricity, cabin fee and other supplies. We compared this value with the current cost for jet fuel airplane and we summarized that the fuel price and the maintenance in electric plane can be reduced from approximately 3.1M\$ to 2000\$.

During the project, I mainly worked on with the cost of the electricity. First, I only considered about the cost of the electricity itself and looked at the current price. However, as class went on, I noticed that considering only about the current price does not help our project. This is because our project cannot be started immediately. Electric airplane is an important project should be considered immediately. However, there are still many problems that needs to be considered. Therefore, electric airplane is a project that needs to be experimented in a long term.

In our project, we considered electric airplane to be achieved to be used in normal market by 2035. Therefore, I needed to consider the price of electricity at that time. Adding to this, I noticed that the price of the electricity will be affected by the amount of electricity we need. The need of electricity is rising time by time and if we ask for more electricity to the powerplants that we have right now, it is obvious that the electricity price will rise. Adding to this, the trend of producing electricity is tilting to be eco-friendly. This means that we need to also depend more on renewable sources. Due to the aim, made me possible to think to add an option about creating a new powerplant to afford all the electricity we need.

The cost needed for creating a new powerplant is called Levelized Cost of Electricity and found out that LCOE is the summation of two costs, which are Capital expenditure and Operation expenditure. Capital expenditure is the initial price for building the facility. The operation expenditure is the cost that we need to run the facility in the future. I looked for the LCOE price for Solar power and Wind power. These were chosen because the CO₂ emission was smaller than other technologies. I created a graph that shows the change of the price of the LCOE cost during time and read the trend of the cost

through it. I have also calculated the jet fuel price for reference. At the end I summarized that Solar power photovoltaic utility showed to be the most reliable technology we could in our project. My part helped our project to be lower cost, since fuel is the largest part that is included in the cost of the price of the seat for airplanes now.

The workshop we did just after the mid term presentation was fun. The workshop was about giving new and unique ideas for a group that we are not mainly working on. I went to the Monster truck group and gave an idea that changes the height of the floor and not the bridge, tunnel, or the pole. It is simply fun for people who is not in the main group to give unique ideas to other groups even though it is not achievable. Adding to this, doing the workshop in small groups made me understand the topics of other groups more and made me feel more interested about the project, than just listening to the presentation they give to the whole class. This is because smaller groups helped us to ask more questions. However, I think that giving new ideas widen the way of thinking for the main group. When people focus on one idea, it is hard for them to notice other people's perspectives that might help them make their idea more interesting and achievable.

I was also able to learn how to ask questions after the presentations. I found it hard to ask questions to other groups but the frequent question section and listening to other people asking question helped and taught me how to ask a good question.

[END of ESSAY]

Please do the followings:

1. First, define a rubric that will serve as the evaluation criteria.
2. Explain the existing theory behind determining the above rubric.
3. Use the rubric to evaluate the student's reflection essay above on a scale of 30 points.
4. Explain the reason why you gave the above points.

1. Evaluation Rubric Definition

The evaluation of the student essay will be based on the following criteria, each with a maximum score of 10 points, totaling 30 points:

a) Content and Clarity (10 Points)

- Project Description: Clear explanation of the project, its goals, process, and outcomes.
- Contribution: Detailed description of personal contributions to the project.
- Reflection: Insightful reflection on learning and experiences.

b) Depth of Analysis (10 Points)

- Critical Thinking: Demonstration of critical thinking in analyzing the project's challenges and solutions.
- Problem-Solving: Evidence of problem-solving skills in addressing project issues.
- Innovative Thinking: Originality and creativity in approach and ideas.

c) Communication and Structure (10 Points)

- Organization: Logical flow and structure of the essay.
- Clarity: Clarity of expression and ease of understanding.
- Grammar and Syntax: Correct use of grammar, spelling, and punctuation.

2. Theory Behind the Rubric

The rubric is based on educational and assessment theories that emphasize:

- Bloom's Taxonomy: Evaluating the student's ability to apply knowledge (Content and Clarity), analyze and synthesize information (Depth of Analysis), and evaluate and create new ideas (Innovative Thinking).
- Constructive Alignment: Ensuring that the evaluation criteria align with the learning outcomes of the course (i.e., understanding technology, fostering motivation, groupwork).
- Communication Skills: Assessing the student's ability to effectively communicate their ideas and reflections, which is essential in any educational setting.

3. Evaluation of the Student's Reflection Essay

a) Content and Clarity: 7/10

- The essay adequately describes the project and its goals but could provide more detail about the process and specific outcomes.
- The student's role and contributions are mentioned, but more depth could be provided.
- The reflection section shows some level of insight but lacks depth in terms of personal learning and growth.

b) Depth of Analysis: 8/10

- The essay demonstrates good critical thinking, especially in the analysis of electric airplanes.
- There is evidence of problem-solving, particularly in tackling the issues related to cost and electricity.
- Innovative thinking is present, but more unique solutions or approaches could have been highlighted.

c) Communication and Structure: 6/10

- The essay is generally well-organized, but transitions between topics could be smoother.
- The clarity of expression is satisfactory, but some sections are a bit convoluted.
- There are minor grammatical and syntactical errors.

Total Score: 21/30

4. Reasoning for the Points Awarded

- **Content and Clarity:** The essay provides a good overview of the project and the student's role, but it lacks in-depth reflection on personal learning and detailed explanation of the project's process and outcomes.
- **Depth of Analysis:** The student shows a good level of critical thinking and problem-solving skills, especially in addressing technical aspects of the project. However, the innovative aspect could be more pronounced.
- **Communication and Structure:** The essay is readable but could benefit from better organization and clearer expression. Minor grammatical errors detract slightly from the overall quality.