**UNITED ARAB EMIRATES
MINISTRY OF EDUCATION**

Student Guidebook

Project Based Learning and Assessment

Name:

Grade, Stream, Section:

Subject:

Table of Contents

Introduction

Welcome to Project-Based Learning and Assessment (PBLA)

Project-based Learning and Assessment (PBLA) is a way of learning by doing! It is a different way of learning and getting grades than taking tests. It helps us work on solving real world problems, learn about big issues and think of new ways to make a difference. Working on projects also helps us learn important skills.

Through PBLA, I can:

- **explore real-world problems**
- **build important skills**
- **work well in a team**
- **be innovative**
- **show what I have learned**

I promise to:

- connect our projects to our community
- respect our classmates' different backgrounds and skills
- understand what our projects are about and how they will be graded
- share ideas with others
- appreciate what everyone brings to our projects
- listen to our teachers' feedback and use it to learn and get better

This guide will help me with my PBLA journey. It tells me what I need to do to get good scores and show my best work in PBLA. I am ready to work hard, create, and make a positive difference!
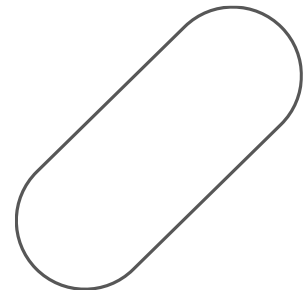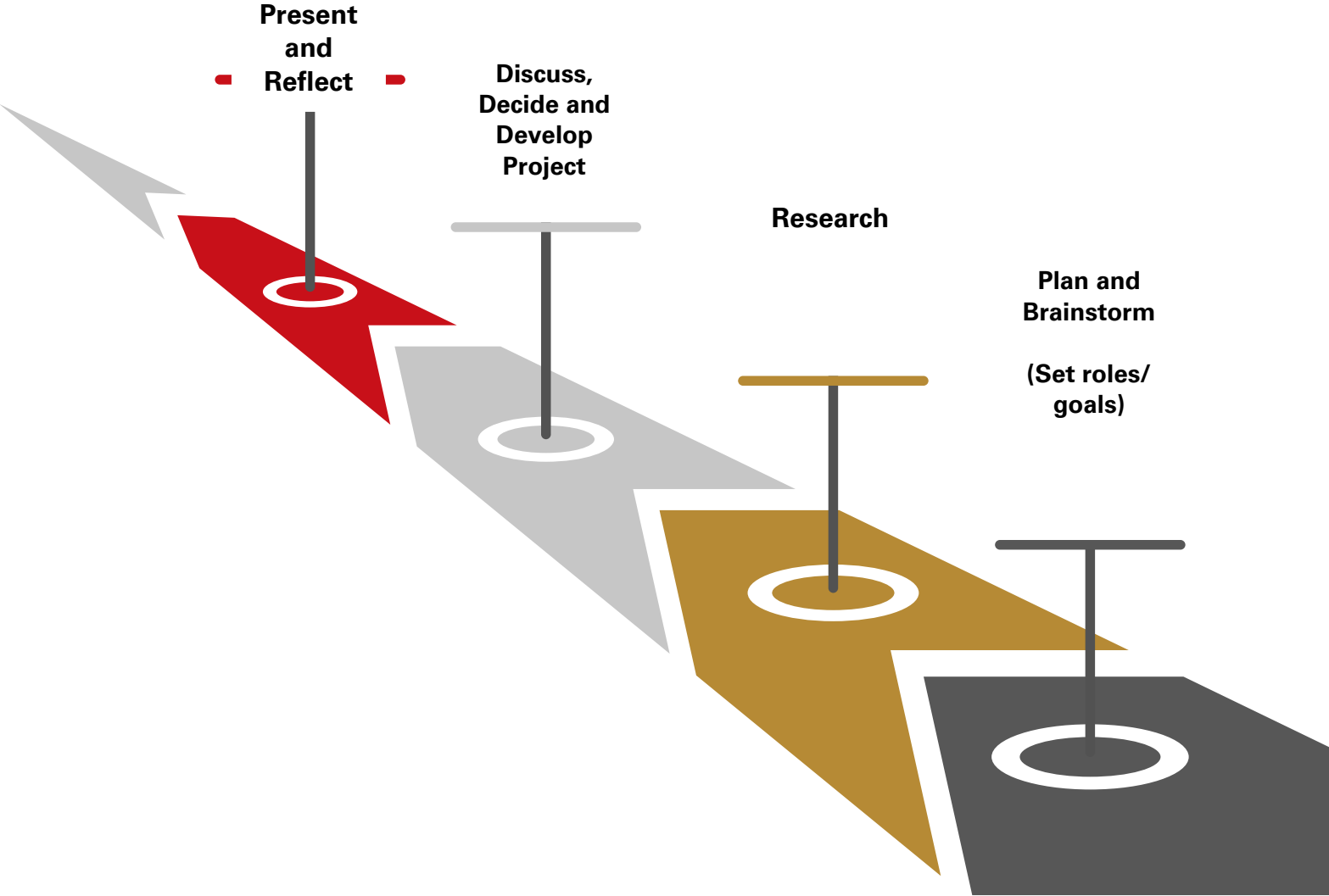
Brief description of the Project

My project is about: Exploring the importance of inequalities through an engineering context involving the design and operation of the Etihad Train project. I will research how mathematical inequalities are applied in real-world scenarios such as determining maximum cargo loads, setting speed limits, scheduling, and ensuring passenger safety on the Etihad Train.

We will produce: An Operational Safety Guide for Al Etihad Train (using tools like paper, graphs, tables, posters, and digital tools) that includes all of our investigations. The final product (Operational Safety Guide) must answer the project essential question in an effort to propose solutions that are related to the UAE. For this particular project, the essential question is: How can we apply inequalities to help engineers optimize the design of the Etihad Train project to enhance the transportation experience in the UAE? In other words, ensure that our final project answers the essential question and proposes clear solutions and models from our investigations and creativity exercise.

My learning journey of the Project

Present and Reflect

Discuss, Decide and Develop Project

Research

Plan and Brainstorm

(Set roles/ goals)

Project Overview

Subject	Math
Project title	Al Etihad Train & the Journey of Inequality Symbols
Project objective	We will understand and apply Inequalities to Al Etihad Train Project to enhance transportation experience in the UAE.
Essential Question	How can we apply inequalities to help engineers optimize the design of the Etihad Train project to enhance the transportation experience in the UAE?

Steps for Success

We will be evaluated on:
- Research and inquiry
- Collaboration, communication, and contribution
- Self-regulation and engagement
- Problem-solving and critical thinking
- Content Mastery:
    - Mathematical accuracy.
    - Mathematical vocabulary.
    - Clear and logical explanations of all mathematical solutions.
    - Clear and logical explanations of inequalities and their verification.
- Presentation skills
- Innovation and enterprise
- Application of knowledge

Materials We Might Need

The following are suggested materials to choose from:

1. Graph paper.
2. Rulers.
3. Colored pencils.
4. Reference materials on inequalities and Al Etihad Train (textbook, internet resources).

Roles and Responsibilities

My Group Project Roles and Responsibilities

NAME OF STUDENTS

ROLES AND RESPONSIBILITIES

I know that AI tools, like ChatGPT, can help me learn, but I will use them positively.
- My work will show what I know, what I can do, and how hard I worked.
- If I include any ideas from AI, I will be honest and let people know.

I can use AI to:
- get guidance
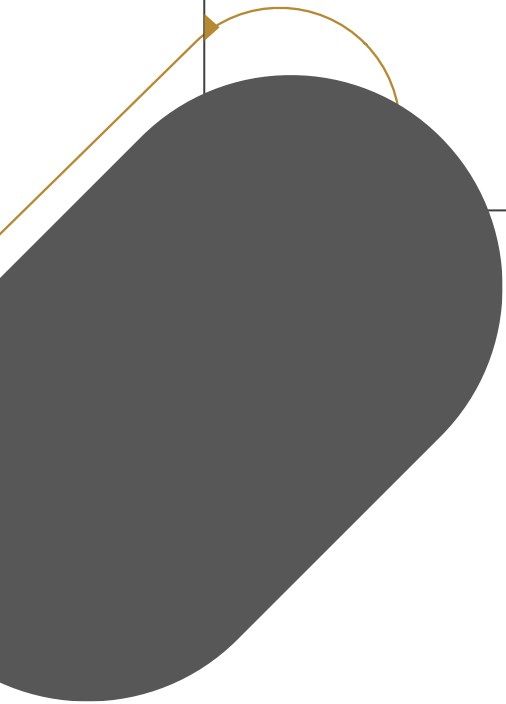- brainstorm ideas
- check our understanding

Roles and Responsibilities
MY GOALS

What do I want to do? How will I use my time in the best way?

▶

▶

▶

▶

▶

▶

What do I want to learn more about?

▶

▶

▶

▶

▶

▶

Milestones 1 and 2

Milestone 1 Self-regulation and engagement

Thinking about my learning:

Description: I am excited and ready for this work, and I can set goals for myself.

Select your level:	☐ Beginning	☐ Developing	☐ Acquired
Self-regulation and engagement	I find it hard to do this project work. I find it hard to set my goals.	I feel ready for the project and feel like I will try my best. I can think of a goal, but I need some help to understand the idea more.	I am excited about the project, and I am ready to work hard on it. I have a good idea of what learning goals I want to achieve.
Action Plan for Improvement	Action:		

Milestone One – Operational Safety Guide Introduction

Research and Planning:
As I am working on creating my **operational safety guide**, I always remember to keep the main question in mind: **How can we apply inequalities to help engineers optimize the design of the Etihad Train project and improve transportation in the UAE?**
I will write about my research and the resources I use, like books, websites, or videos, and explain what I learn about **inequalities and the Etihad Train in the UAE**. We will share ideas as a group and come up with a solution to the question. Then, we will create a timeline to make sure we finish the problems on the next pages before the project is due:
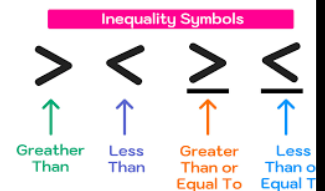
_____

____.

Personal Role:
Our Group Members: _____ _____ _____

_____
In our group, I will explain what my role is and how it will help us succeed as a team. I'll write about how my work connects to what my teammates are doing. I will also make a plan for myself to meet my goals, stay organized, and give my best effort. If I run into challenges, I'll think of ways to solve them so I can keep helping our group.

Answers:

Thinking about my learning:

Description: I can find out more about the topic. I can ask questions to help us think about it.

Select your level:	☐ Beginning	☐ Developing	☐ Acquired
Research & Inquiry	I found it hard to find reliable sources of information. I found it hard to think of research questions.	I found some good information from my sources. I asked some good questions to help us think about the system	I found a lot of reliable sources. I could connect ideas between them. I asked big questions which made the group really think hard.
Action Plan for Improvement	Action:		

Operational Safety Guide Sections

- ***CCSS 6.EE.5: Solving Inequalities***

   Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.
   (Equivalent to MAT.2.02.05.002)

Main Goal:

Let's work together to create an **Operational Safety Guide** for the Etihad Train. We'll solve real-world engineering challenges and use math inequalities to keep the train running at its best. Our goal is for the train to be safe, efficient, and comfortable for everyone who rides it.

The Scenario:

As an engineering team, we need to complete the Etihad Train's operational guidelines. Each section poses a real-world challenge—from managing passenger capacity to setting speed limits and luggage restrictions. We'll use inequalities to find safe, effective solutions. By working through these problems, we'll collect our findings into a comprehensive Operational Safety Guide that future train engineers and planners in the UAE can use.

Contribute to the Operational Safety Guide section 1:

By accomplishing these objectives, you will enhance the Operational Safety Guide with practical insights on speed management, ensuring that the Etihad Train excels in both safety and performance.

Welcome aboard, engineer!

- **Passenger Capacity Scenario – Creativity:**

   Let's start with passenger comfort and safety. Write an inequality that shows the maximum number of passengers (p) per carriage. This inequality makes sure no carriage goes over the limit.

   You will use this inequality in the first section of your Operational Safety Guide. It shows how mathematical constraints help operators and passengers understand and follow seating limits. If we follow this rule, the Etihad Train can avoid overcrowding, and have safe and comfortable seating plans.

- **Freight Management Scenario - Creativity:**

   Next, make sure the Etihad Freight Train runs within safe weight limits.

- The inequality $2c + 150 \leq 1200$, where c is the cargo weight in tons and $150\ tons$ is the empty train's weight, sets the maximum load.

- Once you find the safe cargo limit, calculate how many $50 - ton$ containers can be safely carried. This calculation helps operators make safe loading decisions. Include it in your Operational Safety Guide.

- **Mission Objectives** - Let's Sharpen Our Skills to Create the First Part of Our Guide!
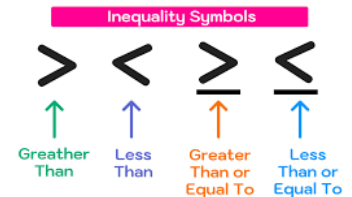
1.1 Passenger Capacity Challenge:
Create an inequality that shows the maximum number of passengers (p) that can be safely seated in one carriage. Include this into the Operational Safety Guide's first section. Demonstrating how mathematical limits support safety and efficiency on the Etihad Train.

1.2 Freight Load Challenge:
Determine the maximum safe cargo weight using the given inequality. Based on that result, figure out how the maximum number of 50-ton containers we can load safely on the train.

Answer: *(Draw all relevant diagrams and show all your work!)*

Inequality Symbols

$>$ Greather Than $<$ Less Than $\geq$ Greater Than or Equal To $\leq$ Less Than or Equal To

- *CCSS 6.EE.6 Representing Inequalities*

  Use variables to represent numbers and write inequalities to model real-world situations related to the Etihad Train in the UAE—such as constraints on speed limits, cargo weights, or passenger numbers. Understand that a variable can represent any number in a specified set.
  (Equivalent to MAT.2.02.05.003 & MAT.2.02.05.004)

Contribute to the Operational Safety Guide section 2:

By completing these tasks, you will enrich the Operational Safety Guide with practical strategies for managing speeds. Through careful analysis and comparison, the Etihad Train will continue to excel in delivering safe, efficient, and competitive service.

Welcome to the next stage of your engineering mission!

Scenario: Speed Limits and Comparing Trains - Creativity:

You have already worked on how many passengers and how much cargo the train can carry. Now, let's focus on the train's speed.

Here are the rules for the Etihad Passenger Train:

- The train's speed should not be more than 160 km/h. We write this as $s \leq 160$.
- The train's speed should not go below 120 km/h. This keeps the train on time, and we write this as $s \geq 120$.

Together, these rules create a safe and reliable speed range for the train.

Next, think about other high-speed trains in the world. Research their speed ranges and write an inequality to show one train's operating speed. Adding this to the guide will help compare trains and choose the best models for safety and efficiency.

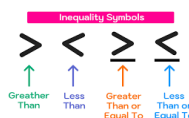**Mission Objectives - Let's Get Started!**

2.1 **Etihad Speed Range Challenge:**

- Show the inequality $s \leq 160$ on a number line to display the train's top safe speed.
- Write another inequality for the minimum speed of 120 km/h ($s \geq 120$).
- Combine these rules to show the train's full speed range.

2.2 **Global Speed Comparison Challenge:**

- Research high-speed trains worldwide.
- Create an inequality to represent one train's speed range.
- Add this inequality to the guide to help compare speeds and make decisions that keep the Etihad Passenger Train efficient, safe, and on schedule.

Answer: *(Draw all relevant diagrams and show all your work!)*

Inequality Symbols

>   <   ≥   ≤

Greather Than   Less Than   Greater Than or Equal To   Less Than or Equal To

- *CCSS 6.EE.8: Writing Inequalities*
  Write an inequality of the form $x > c$ or $x < c$ to represent a constraint or condition in real-world problems related to the Etihad Train in the UAE—such as maximum luggage weight, passenger limits, or speed restrictions. Recognize that such inequalities have infinitely many solutions and represent them on number line diagrams.
  (Equivalent to MAT.2.02.05.005)

Contribute to the Operational Safety Guide section 3:
By completing these tasks, you'll make the Operational Safety Guide a helpful tool for passengers and the train company to follow safe and efficient travel rules.

Ready for Your Next Assignment, Engineer?

Scenario: Luggage Restrictions and Passenger Compliance – Creativity:

Imagine you're a designer and engineer working on the Etihad Train's safety policies! Your next challenge is to make sure passengers and their luggage follow safety rules.

1. **Current Luggage Policy Challenge:**
   o Each passenger's luggage (w) must weigh less than 30 kilograms. Write this as an inequality.
   o Show this inequality on a number line to show what weights are acceptable for luggage.

2. **Combined Weight Restriction Challenge:**
   o A new rule says the total weight of both luggage (w) and carry-on items (c) must be less than 35 kilograms.
   o Create an inequality to express this rule and show it in the guide's third section.
   o Presenting these luggage rules as inequalities helps passengers understand, remember, and follow safety rules, making sure the Etihad Train stays safe and efficient for everyone.
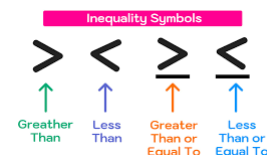
- **Mission Objectives - Let's Get Started!**

   3.1 **Current Luggage Policy Challenge:**
   Write an inequality showing that a passenger's luggage (w) must be less than $30\ kilograms$.
   Represent this inequality's solution on a number line to visualize acceptable luggage weights.

   3.2 **Combined Weight Restriction Challenge:**
   Suppose a new policy requires $w + c < 35\ kilograms$, where c is the carry-on item's weight. Create an inequality to express this restriction. In the guide's third section, explain how presenting these luggage rules as inequalities helps passengers easily interpret, remember, and comply with safety regulations, ensuring that the Etihad Train maintains high standards of safety and efficiency.

Answer: *(Draw all relevant diagrams and show all your work!)*

Inequality Symbols

$>$ $<$ $\geq$ $\leq$

Greather Than   Less Than   Greater Than or Equal To   Less Than or Equal To

Contribute to the Operational Safety Guide section 4:

By completing these tasks, you will enhance the Operational Safety Guide with actionable insights on scaling passenger capacity responsibly. Your mathematical reasoning and careful analysis will ensure that even when demand peaks, the Etihad Train continues to operate safely, efficiently, and in full compliance with essential regulations.

Prepare to apply your engineering expertise once again, engineer!

- **Scenario: Scaling Capacity for Peak Demand – Creativity:**

  It's time to tackle a new challenge: the Etihad Train company is considering adding more carriages to handle peak travel times. Each carriage provides a certain number of seats, but the train has strict limits on how many carriages it can safely operate."

  In this fourth section, you will show how representing constraints on carriage numbers and seating capacities as inequalities empowers planners to easily interpret, compare, and make well-informed decisions. By applying mathematical strategies, the Etihad Train can meet high passenger demands without surpassing operational limits, maintaining both safety and efficiency.

- **Mission Objectives - Prepare yourself, engineer, and get ready to tackle these capacity-based challenges—ensuring the Etihad Train is ready for peak demand!**

  4.1 Research and Data Collection Challenge:
  a. Gather or estimate the seating capacity per carriage. If exact figures are unavailable, assume each carriage seats $80\ passengers$.
  b. Consider the constraints: The train can have a maximum of $12\ carriages$ and needs at least $500\ seats$ to meet peak travel demands.

  4.2 Defining Variables and Writing the Inequality Challenge:
  a. Let c represent the number of carriages.
  b. Let s represent the seating capacity per carriage.
  c. Form an inequality ensuring that the total seating meets the minimum passenger requirement while not exceeding the maximum carriage limit.

  4.3 Table and Graph Challenge:
  a. Create a table listing various values for c and compute total seating for each scenario.
  b. Identify feasible solutions that satisfy both the minimum seating requirement and the maximum carriage limit.
  c. Represent these solutions on a graph, visually demonstrating how inequalities guide smart decision-making.

  4.4 Application and Recommendations Challenge:
  a. Explain how understanding this inequality helps the Etihad Train company plan for peak travel times.
  b. Provide recommendations on how to accommodate more passengers without exceeding operational limits.

Answer: *(Draw all relevant diagrams and show all your work!)*

4.3: Example

Number of Carriages (c)	Total Seating Capacity (80c)	Meets Minimum Capacity?
6	480	No
7	560	Yes

Thinking about my learning:

1) Collaboration, Communication & Contribution

Description: I discuss well in my group and help organize our tasks.

2) Problem-solving & Critical thinking

Description: I can see problems, find solutions, and change as needed.

Select your level:	☐ Beginning	☐ Developing	☐ Acquired
Collaboration, Communication & Contribution	I only spoke a little about the project.	I gave some ideas to the group and helped to come to decisions.	I gave many original ideas and I helped organize our work.
Select your level:	☐ Beginning	☐ Developing	☐ Acquired
Problem-solving Critical Thinking	I found it hard to solve the problems. My teammates made all the decisions.	I could see some of the problems and I tried to think of ways to fix them. Sometimes, I need help for making decisions.	I thought about different and original solutions and shared them with my team.
Action Plan for Improvement	Action:		

Milestone Two: (For All Students)

Reflection on Work:
I need to reflect on our completed project on <u>Inequalities and Etihad Train</u>. I will think about the project we worked on and what we did well. What were the best parts of our work? I'll give examples of things we're proud of and why they were successful. I'll also think about areas where we can improve and explain how our planning and teamwork helped make our project strong. What part of the project am I most proud of, and why?
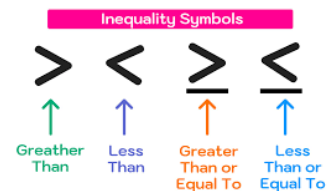
Demonstrating Closed Gaps:
I'll think about challenges we faced or areas where we needed to learn more. How did I work to improve during the project? I'll give specific examples of strategies I used, like trying new methods or asking for help. I'll also explain how fixing these gaps helped make our project better.

Reflection on Learning:
I'll reflect on what I learned during this project. What new skills or ideas did we gain? How has this project helped me or us understand the topic better? I'll also think about new learning goals for the future and why they are important.

Answer:

Inequality Symbols

> Greather Than
< Less Than
≥ Greater Than or Equal To
≤ Less Than or Equal To

Milestone 2: Presentation and Reflection

What will be my role in the presentation:

_____

_____

_____

_____

What have I learnt:

_____

_____

_____

_____

How does the project connect to the real world:

_____

_____

_____

_____

_____

Thinking about my learning

1) Presentation Skills: I can present well to my classmates			
Select your level:	☐ **Beginning**	☐ **Developing**	☐ **Acquired**
Presentation Skills	I find it hard to talk in front of people. I find it hard to explain what I learnt.	I find it easy to talk to the class and they could understand me. I find it easy to say something about what I learnt, and how I solved problems in the work.	I find it very easy, and I feel confident talking to the class. I find it very easy to describe how we fixed problems and what I learnt.

2) Innovation: We used new and original ideas and our presentation was creative			
Select your level:	☐ **Beginning**	☐ **Developing**	☐ **Acquired**
Innovation	We needed ideas to make our presentation more original.	I thought we had some new and original ideas. We had some new and interesting ways to do our presentation.	We had very creative ideas. We presented our ideas in a really exciting and different way.

3) Content/Topic Mastery: I understand and can explain this topic.			
Select your level:	☐ **Beginning**	☐ **Developing**	☐ **Acquired**
Content/Topic Mastery	I only know a few simple things about this topic. I found it hard to understand the ideas that were said	I understood most of what the class said on the topic. I need some things explaining more.	I feel like I understand everything on this topic and I can explain it to people.

4) Application of Knowledge/Skills: I connect what I've learned to real-world situations.			
Select your level:	☐ **Beginning**	☐ **Developing**	☐ **Acquired**
Application of Knowledge/Skills	I found it hard to understand how this will work outside the classroom.	I can think of some examples of how this will work outside the classroom. I need some help to think of more ideas.	I feel like I have really good ideas about how this will help people outside the classroom.
Action Plan for Improvement	Action:		

My Final Reflection
What did I learn and how did I improve?

What was good about my project?

What can I make better in my project?

What other skills have I improved? What skills do I still need to work on (e.g. time management, confidence, etc.)?

What have I learnt doing the project?

Did I achieve my role? Am I proud of the work I did?

Write a thank you note to yourself