Rube Goldberg Challenge

Brauer College

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Year 7 Science

The Context

- Brauer College
- Year 7
- Coast FM, Warrnambool Standard, Parents
- Science- Forces
- Improving task collaboration skills

Background:

We saw this as an opportunity to develop some collaborative problem solving skills in our students while still covering the content of the Science course. It was also an opportunity for us to try something different and to give students more ownership of their learning.

Competition Day Video

The Task

What was done:

- The students were presented with a design brief that required them to work collaboratively to research and construct a Rube Goldberg Machine.

Length:

- 5 Weeks during timetabled Science classes of 3 X 47 min periods per week.

Year 7 Rube Goldberg Challenge – Design Brief

You work as a part of a design team for World-renowned watchmakers Rolex. Their company is based in Switzerland but you are a part of their Australian team and have been selected for a very important challenge.

Rolex are very well known for their perfection and the amazingly accurate timepieces they create. They are also a very generous company and sponsor many different events around the world. One of the most famous is the Rolex Sydney to Hobart yacht race held on Boxing Day each year.

At the start of the race there are two guns fired, five minutes apart. The first gun is the 'five minute' warning gun, which tells competitors that the start gun will fire in exactly five minutes time. It is imperative that the start gun goes off exactly five minutes after the warning gun or some of the boats may either be not close enough to the line to get a good start or may actually cross the line too early and be penalised.

Rolex are after a team of people to design a device that measures exactly five minutes, so they know that the second gun is fired exactly five minutes after the first.

To determine which team will be chosen as the winners of the design, all teams must build a prototype device that measures exactly 20 seconds. The winning team will be invited to work on the 'five minute' device based on their prototype design.

The criteria for the design are:

1 – It must accurately measure 20 seconds on three consecutive occasions.
2 – It must show creativity and ingenuity and combine at least 4 different stages.
3 – It must be confined to a space no bigger than one classroom desk and one meter of floor space around it.

The task continued …

Content goals (AusVELS):

- Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge.
- Science knowledge can develop through collaboration and connecting ideas across the disciplines of science.
- Change to an object’s motion is caused by unbalanced forces acting on the object.
- Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed.
- Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate.
- Reflect on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected, and identify improvements to the method.

The task continued …

Year 7 Rube Goldberg Challenge Unit Outline

Week	Activity	Resources	Comments	Curriculum AusVELS
1	Explain to students what we are doing for the next 4-5 weeks. (Collaboration, Science, Rube Goldberg competition)	If you wanted to you could show this video as a hook. Audri's Monster Trap. https://www.youtube.com/watch?v=lMbol4cOAuQ Mp4 included in electronic package.		Identify questions and problems that can be investigated scientifically and make predictions based on scientific knowledge. Science knowledge can develop through collaboration and connecting ideas across the disciplines of science.
	Self Assessment Sheet	Self Assessment Sheet	This will also help provide the language for the Brainstorm. Collect all self-assessments. Video/photo students.	
	Brainstorm – What is Collaboration?	Collaboration v's Group doc. On the Board, Padlet, Think-Pair-Share/Answer Garden	Photo or screen shot brainstorm activities. Video/photo students.	
	Introduce Rube Goldberg Design Brief.	Design Brief for task.	Group students into teams of three. (four max, not 2's).	
	Planning using the Solution Fluency. Why and how to plan. Using the QFT to generate questions for the 'Discover' phase.	Planning using the fluencies doc. QFT Document	Students must complete and submit their entire plan prior to construction. (Not the Debrief)	
2	CPS – Collaborative Problem solving	Online program in Computer Rooms	Staff to do this at KLA Tuesday (half an hour with Anthony J and Delia)	Change to an object's motion is caused by unbalanced forces acting on the object. Collaboratively and individually plan and conduct a range of investigation types, including fieldwork and experiments, ensuring safety and ethical guidelines are followed.
	Design Rubric with student voice.	Rubric proforma. *(Completed as an example of what it may look like.)* One recommendation would be to delete Emerging, Developing and Accelerating and ask the students what should go in these three columns.	We will gather all inputs from each of the classes and I will generate one rubric, which we will all use.	
	In their team, students to plan their solution to the design brief using the Solution Fluency.	Planning using the Fluencies doc. Solution Fluency graphic.	You may wish to designate specific jobs to different team members depending on what you think their strengths may be.	

The task continued …

3/4	Model Construction	Check to see if you need to support teams with any specific resource requests. Students should also be keeping a record of their work. Photo/Video snippets.	Video/Photo Capture Remember that models need to be able to be set up for each class and for competition day. Look for formative assessment opportunities. Talking with students to gauge their understanding of the task and how well the team is functioning collaboratively.	Science knowledge can develop through collaboration and connecting ideas across the disciplines of science.
5 Maybe wk 6 if more time needed	Model Construction Competition Day.	Date to be confirmed.	Hopefully we will involve the media. We will post to our webpage, facebook, twitter etc.	Communicate ideas, findings and solutions to problems using scientific language and representations using digital technologies as appropriate. Reflect on the method used to investigate a question or solve a problem, including evaluating the quality of the data collected, and identify improvements to the method.
	Student Reflection.	Collaboration Task Reflection sheet. 15 – 20 mins They should also complete the Debrief part of the solution Fluency planning sheet. 5 – 10 mins.	Please collect all reflection sheet and Solution fluency sheets.	
	Assess students using the DLCF (Deep Learning Competency Framework rubric) for Collaboration.	DLCF Rubric excel sheet.	Please submit all DLCF assessments to Delia.	
	Assess each team against the rubric/Students self-assess/peer assess?	Assessment Rubric.	I will need some samples of results please.	
Later	Team Debrief and reflection on activity.		During next available KLA time.	

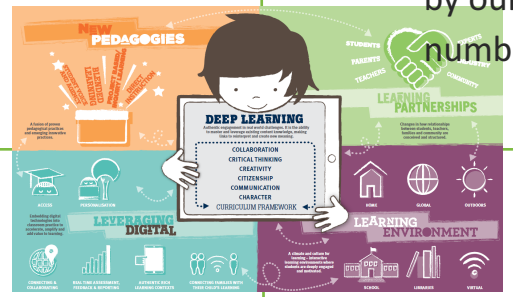
Pedagogical practices –

- Collaboration
- Real World Scenarios

DEPTH – Students did a lot of work understanding what collaboration is and the specific skills required to be a good collaborator. They then put this into action using a real world scenario with a task that challenged them to learn about the Science involved.

Learning partnerships –

This activity involved all the Year 7 Science classes and their teachers. Our Technology KLA assisted with some scrap materials, especially wood. We also had the support of the local radio station (Coast FM) as one of their presenters is involved in the College's Standing Tall program. He advertised our Challenge Day for us and interviewed out students on the radio about the what they had been doing in preparation. On the Challenge Day our local newspaper (The Standard) came and did an article for us and we were also supported by our parents through out the preparation by supplying materials. A number of parents also attended to watch on the day.



Leveraging digital –

- Internet - For research
- You Tube – For research
- Padlet – For formative assessment
- Google Docs – For sharing ideas and collaboration

Learning environments –

- Really noisy (very productive) classrooms
- School Gym for Challenge Day

The task score

The Assessment Rubric was developed in conjunction with the students. They helped form the criteria based on the Design Brief and contributed to attributes they felt needed to be shown for each of the different grading scales.

Each class discussed this in different ways and provided feedback to the teachers before the rubric was finalised.

Students Self assessed the first three criteria as teams and the final component was teacher assessed.

Year 7 Rube Goldberg Challenge

Assessment Rubric

Criteria	1 - Limited	2 - Emerging	3 - Developing	4 - Accelerating	5 -Proficient
Construction of the machine, meeting the criteria.	A complete machine was not built.	A machine was built but was not within the designated space or did not have four distinct stages.	A machine was built within the confines of the designated space and had more than two distinct stages.	The entire machine was built within the confines of the designated space and has at least four distinct stages.	The machine exceeded all requirements showing innovation, ingenuity and creativity of design.
The accuracy of the machine as a measurement of time.	The machine failed to run from start to finish.	The machine ran from start to finish occasionally but did not measure 20 seconds on any occasion.	The machine ran from start to finish most times but did not measure 20 seconds on any occasion.	The machine ran from start to finish and measured 20 seconds on some occasions.	The machine ran from start to finish and accurately measured 20 seconds on three consecutive occasions.
Collaboration	The team members worked independently and did not make decisions together. Interpersonal and team related skills were not present. Individuals tend to see things only from their own perspective.	The team has identified some individual tasks that need to be completed. Decisions are not made collectively. Individuals are beginning to understand how their behavior affects others.	The team decides together how to match tasks with individual strengths and make joint decisions about important issues, processes and solutions. They demonstrate shared responsibility and listen well to others points of view.	The team clearly understands how they should work together and this is evident as they work. They understand the need for joint responsibility They have a strong sense of self and others viewpoints and work effectively to support the team.	The team demonstrated a highly effective interdependent approach to the construction of their machine with all members taking active responsibility, individually and collectively for the final product, being considerate of each member in the group and the skills they possess.
Able to demonstrate an understanding of the forces involved.	The student showed little knowledge of the forces involved in the different stages of their machine.	The student could describe some of the forces involved in different stages of their machine.	The student showed a clear understanding that there were different forces involved in each part of their machine but was unable to identify all of them.	The student could explain the forces involved in each stage of the machine.	The student could clearly articulate all forces demonstrated in each stage of their machine and how they interacted to enable the machine to carry out its task.

Assessment approaches used

Assessment to [inform practitioners in planning and delivering](#) progressive learning opportunities.

- Students completed a Self Assessment Sheet to evaluate their Social and Cognitive Collaboration skills.
  (Designed around the theories involved with the Melbourne University CPS tasks to help identify the zone of proximal development for each student in relation to their Social and Cognitive skill levels in relation to Collaboration.)

SOCIAL DIMENSION			COGNITIVE DIMENSION	
Participation	***Perspective Taking***	***Social Regulation***	***Task Regulation***	***Knowledge Building***
When given a group activity to complete what are you most likely to do first? A - Start straight away on your own ideas. B - Work with a partner and use their ideas. C - Work with others and share your ideas.	**When working with a partner who is struggling to understand the problem do you -** A - Ignore what they are saying to you? B - Wait and see if they can work it out for themselves? C - Discuss their understanding and help them work it out?	**When working in a group what are you most interested in?** A - What you are doing and how well you are doing it. B - If everyone else is doing their share of the work. C - How well the team is working together to solve the problem.	**When trying to solve problems do you usually -** A - Use random guessing to see if you can get an answer? B - Look closely at the information you have and try to solve the problem? C - Try to get more information from elsewhere to try and find the solution?	**When looking at a problem solving task do you -** A - Focus on all the separate bits of information? B - Make links between the different parts of the problem? C - Reorganise the different parts of the problem so they can be linked together in different ways?
When given a group activity that seems quite hard, do you - A - Usually give up? B - Wait to see what the others will do first? C - Work with others in the group to work it out?	**When working with a partner do you -** A - Ignore your partner's ideas? B - Listen to your partner but stick with your own ideas? C - Make changes to your solution based on what your partner says?	**When working in a group do you -** A - Know only what you are responsible for? B - Have an understanding of what the others are doing? C - Know what all team members are doing and how they are going?	**When trying to solve problems do you -** A - Try to solve it as it is? B - Break it down into smaller pieces? C - Work out what has to be done first and then what comes next and so on?	**When looking at a problem solving task do you -** A - Start solving the parts from the start to the finish? B - Look to see if you do something first it might change what happens next? C - Plan a strategy to make sure you have looked at all possible solutions?
When discussing problems with others do you - A - Wait for others to start the conversation? B - Sit back and listen to what they have to say? C - Ask lots of questions and provide lots of ideas?		**If your group can't reach a shared understanding on a point do you -** A - Do what you decide is right? B - Comment on the differences but still do what you think is right? C - Work with the others until you can all agree?	**When solving a problem with a group do you -** A - Work out what you need to solve your part of the problem? B - Share some of your resources with your group? C - Work out what everyone in the group needs to solve the problem?	**If your solution to the problem doesn't work the first time do you usually -** A - Try the same idea again to make sure? B - Try to come up with another idea? C - Keep changing your ideas until you find one that works?
If you can't solve a problem the first time do you - A - Give up and don't worry about it? B - Get someone else to show you how? C - Keep trying other ideas?		**When working in a group do you -** A - Wait for others to tell you what parts to do? B - Do all of it? C - Work out with the rest of the group, the parts you would be best at?	**If your team is having trouble working something out should you -** A - Wait until they work it out so you know what to do next? B - Try to find a solution for them? C - Work together to try something different?	
When you have an idea for solving a problem do you - A - Keep it to yourself to get a better mark? B - Tell others you have solved it? C - Listen to others people's ideas and share your ideas with others?			**When trying to solve a problem do you -** A - Use only the information you have been given? B - Search for extra information you think you need now? C - Search for information you need now and might need later on?	

SCORING FOR THE SOCIAL DIMENSION

1 point for every 'A' answer = 1 x ____ = ____
2 points for every 'B' answer = 2 x ____ = ____
3 points for every 'C' answer = 3 x ____ = ____
Total points = ____

Divide your total points by **11** to get your score.

SCORING FOR THE COGNITIVE DIMENSION

1 point for every 'A' answer = 1 x ____ = ____
2 points for every 'B' answer = 2 x ____ = ____
3 points for every 'C' answer = 3 x ____ = ____
Total points = ____

Divide your total points by **8** to get your score.

SOCIAL DIMENSION			
3	High Social and Low Cognitive Collaboration Skills	High Social and Medium Cognitive Collaboration Skills	High Social and Cognitive Collaboration Skills
2	Medium Social and Low Cognitive Collaboration Skills	Medium Social and Cognitive Collaboration Skills	Medium Social and High Cognitive Collaboration Skills
1	Low Social and Cognitive Collaboration Skills	Low Social and Medium Cognitive Collaboration Skills	Low Social and High Cognitive Collaboration Skills
	1	2	3
		COGNITIVE DIMENSION	

Using your scores for the Social and Cognitive Dimensions, find where you are placed in the grid to the left. Select one or two areas from each dimension below that you could work on to improve your Collaborative Problem Solving skills.

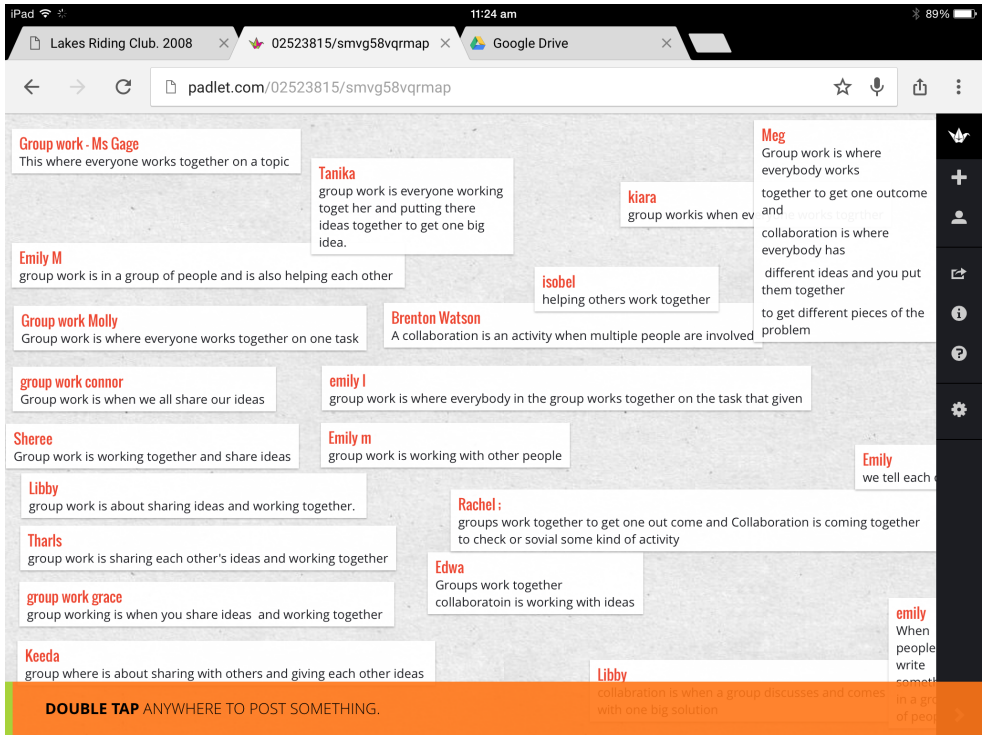
To improve my Social Dimension I could:
- ☐ Work more collaboratively with other students.
- ☐ Accept that it is the whole groups responsibility for the success of the task.
- ☐ Share my ideas and listen better to other member's ideas.
- ☐ Work to resolve conflicts of opinion to help solve the task.
- ☐ Reflect on my own strengths and weaknesses and identify the abilities of other members.
- ☐ Work harder to understand the task and contribute to the solution.

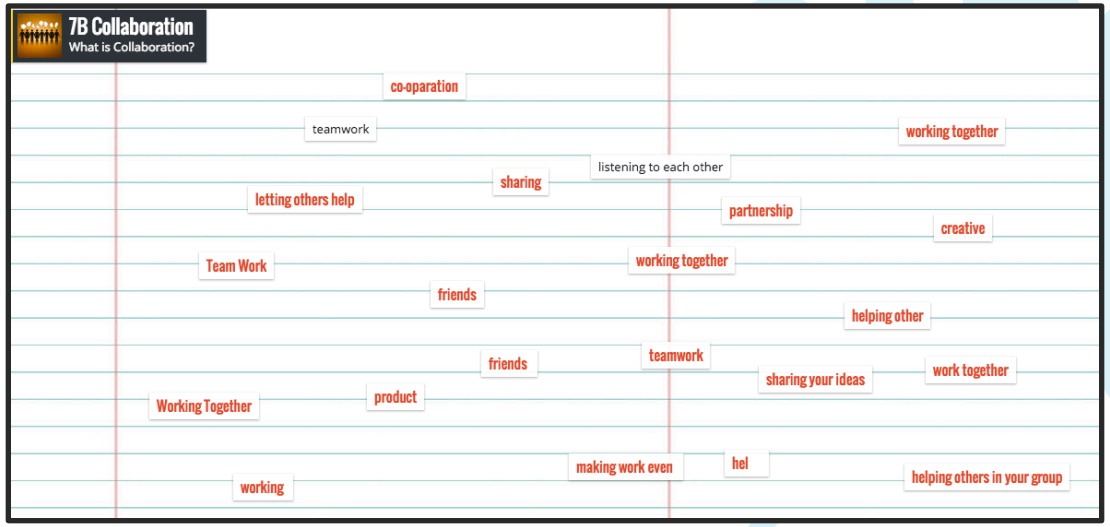
To improve my Cognitive Dimension I could:
- ☐ Identify all the parts of the problem so I can work out the solution in different ways.
- ☐ Work more efficiently and systematically, and use my time more wisely.
- ☐ Explore the problem in more depth and gather as much supportive information as possible.
- ☐ Work out what resources each member of the group might need to solve the problem.

Assessment approaches used

Assessment to [inform practitioners in planning and delivering](#) progressive learning opportunities.

- Students shared what they already knew about Collaboration and how it differs from Group Work.
- This was done using Padlet.





Assessment approaches used

Assessment that enables learners to see and appreciate the progress that they have made and promote further learning and development .

- Video footage of progress.
- Progressive checks against the assessment rubric.
- Peer contributions to their designs, by observations.