

Adapting the principles and practices of lesson study as an approach to teacher professional learning in STEM

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The University of Melbourne

Thursday 20th of June 2019

Session Overview

- The Three Phases of Japanese Lesson Study (JLS)
 1. Pre - Planning
 2. During the Lesson
 3. Post Lesson
- Three Big Ideas from JLS
- An example of Adapted JLS within Integrated STEM
 - The model
 - Recommendations/ Implications
- Application for your school setting?

01



STEP 01

02



JLS

STEP 02

1. Pre Planning

03



STEP 03



1. JLS – Pre - Planning

- Focus on curriculum materials and objectives
- Identify key learning outcomes from the curriculum materials and objectives
- Design a problem-solving task with multiple approaches to allow for different kinds of students' thinking



1. JLS – Pre - Planning

- Identify key questions to be asked during the lesson
- Anticipate student responses and difficulties
- Prepare teaching plan



01



STEP 01

02



STEP 02

JLS

03



STEP 03



2. During the Lesson

2. JLS – During the Lesson

- Organise student groups, functions and questions within the lesson
- Explaining to students about group work and completion of templates for responses
- Presentation of the problem
 - anticipating any difficulties or questions
 - student work
 - monitoring progress
 - identification of work samples
 - whole class sharing
 - wrapping up



2. JLS – During the Lesson



- Observers know what to observe and how to record
- Artefacts to be collected, using a template (pro-forma) for students to record key elements of their problem-solving, including solution process

01



STEP 01

02



JLS

STEP 02

3. Post Lesson

03



STEP 03





3. JLS – Post Lesson

- Feedback from observers (including expert outsiders)
- Analysis of artefacts against student learning objectives and curriculum goals
- What has been learnt about the lesson design?
- How can it be improved?
- How can students' work/thinking be improved within the lesson and after (as a result of the evaluations of artefacts and observers' comments)?
- Prepare next cycle of teaching and learning

Three Big Ideas Behind these three Phases

1. Focus on students' thinking and learning
2. Instructional Design matched to Curriculum and Theory
3. Deep Teacher Professional Learning





STEM

Adapting JLS for Integrated STEM

Context



PSTS participated in **collaborative planning and reviewing their teaching** within a series of **5 weekly lessons** within **upper primary classes** in a Melbourne school.



PSTs observe and respond to each other's teaching, providing real time feedback using 'Padlet'.



They use their mobile phones. The feedback/ observation process is unobtrusive and immediate.



PSTs use the 'Padlet' data later for reflective discussion.

Model for Integrated STEM Professional Learning



CONTENT FOCUSED
LEARNING (GTAC & VSSEC)



PROCESS FOCUSED
LEARNING (JAPANESE
LESSON STUDY)

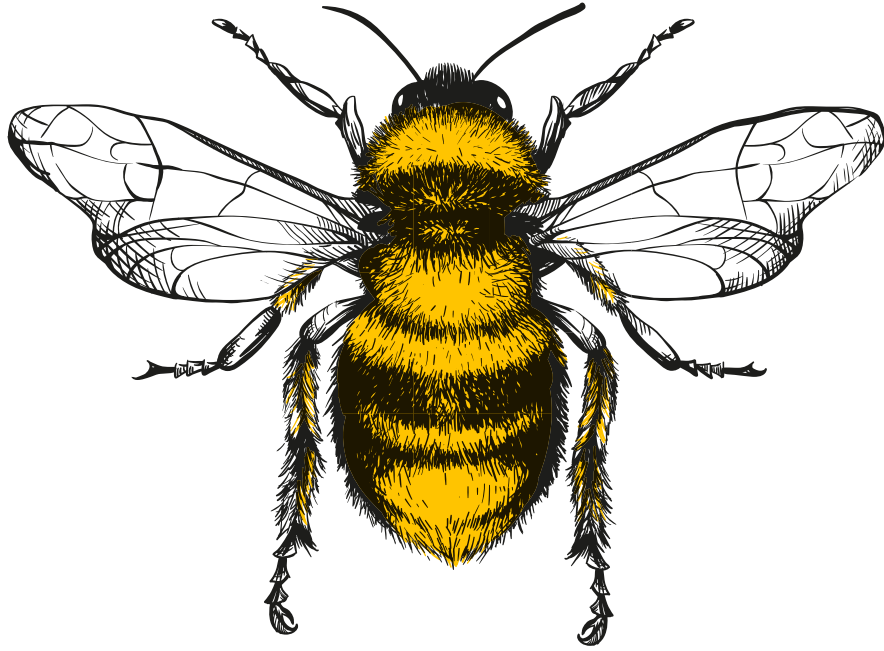


TEAM BASED PLC
PLANNING



5 WEEK TEAM TEACHING
SEQUENCE EMBEDDED
WITHIN SCHOOL





Content Focused Learning

- Teachers need strong content knowledge in the areas they choose to focus on.
- In 2016 professional learning was sought from the Gene Technology Access Centre (GTAC) when planning a sequence focused on bees, pollination and Colony Collapse Disorder (CCD).
- In 2019 the context for integrated STEM was on potential colonization of Mars.
- We therefore sought professional learning from the Victorian Space Science Education Centre (VSSEC) where content knowledge was provided with regards challenges associated with colonizing Mars and basic coding.



Content Focused Learning

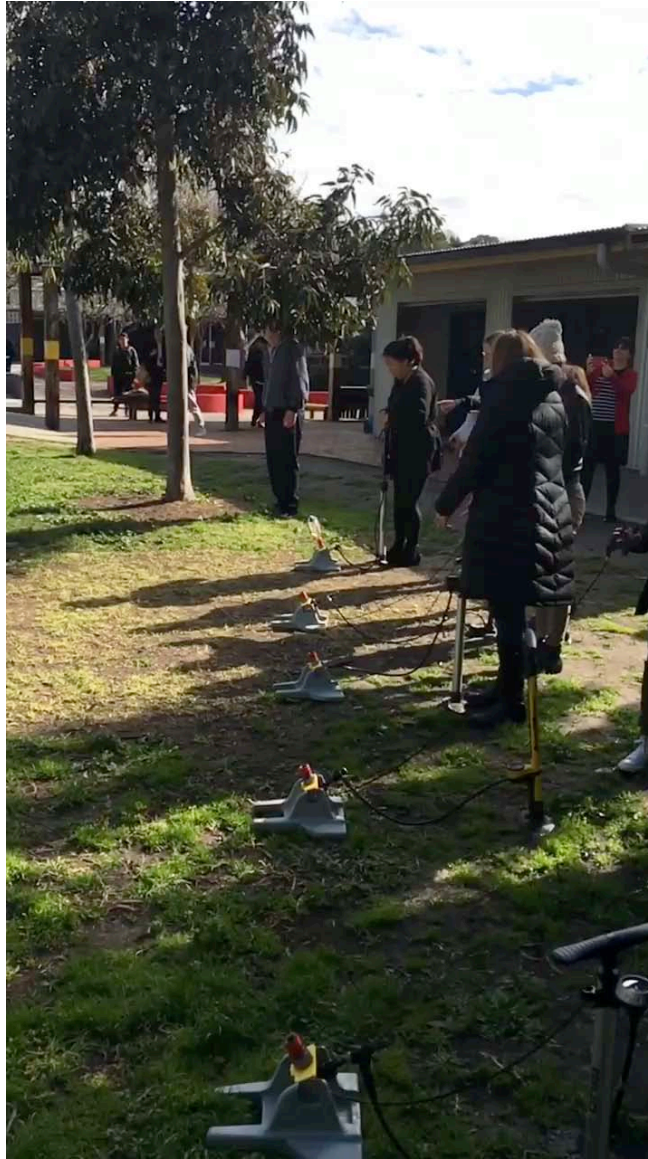
Science Education Partners	University Partners	Scientists	Mathematicians
Royal Melbourne Zoo	Faculty of Science (Physics)	Dr. Frazer Thorpe	Professor Derek Holton
Melbourne Museum	Faculty of Engineering	Dr. Nicole Webster	
The Gene Technology Access Centre (GTAC)		Dr. Ken Walker	
The Victorian Space Science Education Centre (VSSEC)		Dr. Dermott Henry	

Over five years we have collaborated with **scientists, engineers, Science Education Centres** (e.g. GTAC, VSSEC), **MGSE Academics, local schools** and **PSTs**.

Content Focused Learning (Bees, Pollination, and more)

Science	Mathematics
Physical & Behavioral Adaptations	Estimating, reading and comparing angles using a protractor
Negating experimental error when investigating (e.g. sample size, averages etc.)	Negating experimental error when investigating (e.g. sample size, averages etc.)
Exploring variables and fair tests	Measuring and interpreting elapsed time
Symbiotic relationships and how they develop	Interpreting, comparing and creating data representations.
The Importance of Bees (for production of food etc.)	Measuring and comparing lengths with rulers
Domain specific language development	Domain specific language development
Anatomy of Bees	Using scales and rate (e.g. 1cm represents the 1m that bee travels in 1 second)
The roles of Bees in a Colony	

Content Focused Learning (VSSEC)



Process Focused Learning (JLS)



PRE-PLANNING

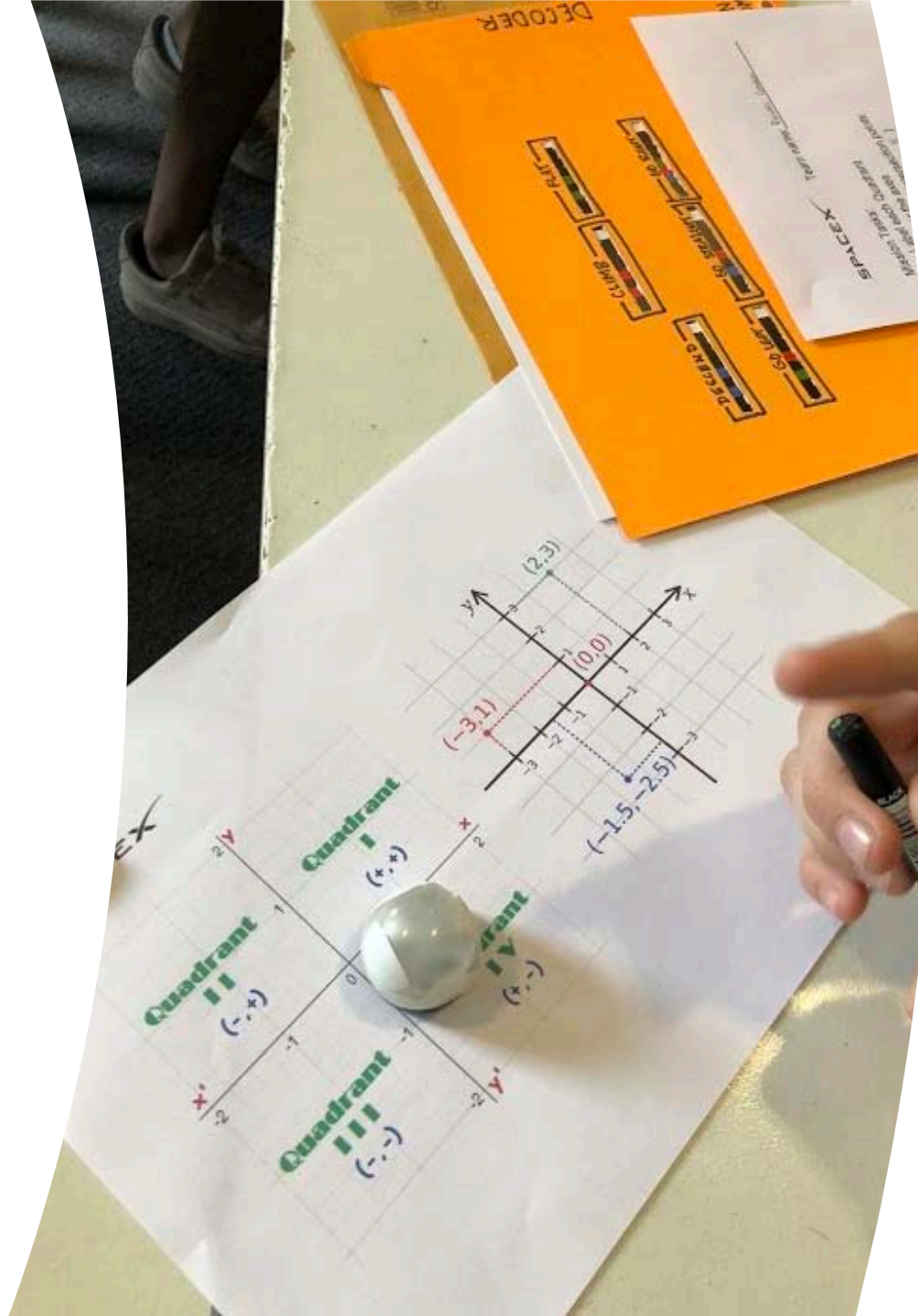


DURING THE LESSON



POST LESSON

Team Based Planning – Pre-Planning (PLC)

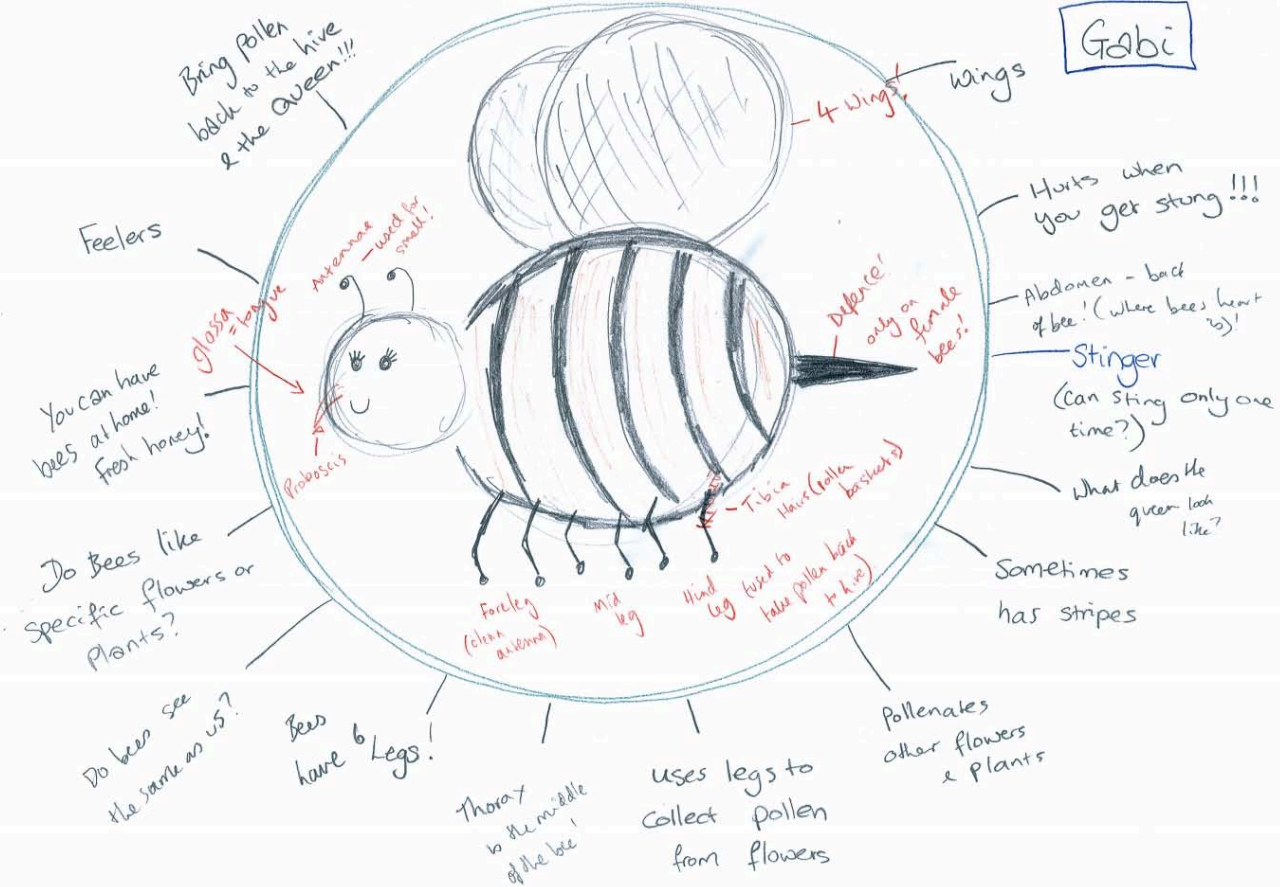


- This team teaching group planned the use of Ozobots to explore sites for investigation on Mars.
- They planned for students to navigate through cartesian co-ordinates across all 4 quadrants.

Quality Criteria	Evaluate/ Expert			3.4 Evaluates effectiveness of student-developed solutions.	4.4 Shows leadership by supporting other group members and self-directing their learning.
	Analyse/ Proficient	1.4 Reflect upon the design of others' food webs	2.3 Ozobot path locates obstacles accurately within the quadrant using cartesian coordinates.	3.3 Demonstrate functional and technical constraints to real-world problems.	
	Apply/ Competent	1.3 Designs a food web that is optimised to support human life in the martian environment.	2.2 Uses legends and directions to interpret information.	3.2 Develops an ozobot program that applies appropriate programs in response to all obstacles.	4.3 Makes active contributions to the group.
	Understand/ Advanced Beginner	1.2 Constructs food webs to show relationships between living things and their environment.			4.2 Passively participates in group by listening to group members and completing assigned tasks.
	Remember/ Novice	1.1 Describes the role an organism plays in a habitat.	2.1 Describes routes using landmarks .	3.1 Creates simple ozobot path.	4.1 Allows other group members to work without interference .
		1. Insufficient evidence	2. Insufficient evidence	3. Insufficient evidence	4. Insufficient evidence
Indicators	Science content		Mathematics content	ICT Skills	Collaboration
Capability Type	Content			Skills	
Module Title	Mission to Mars: The First Colonists				

- This team teaching group planned and constructed a formative assessment Matrix.
- This instrument required the planning of a continuum on understanding in each area.
- The Matrix was planned to assess both content and skills:
 - Science & Maths Content and
 - Digital Technologies and Collaboration

Formative Assessment Matrix



BEEES

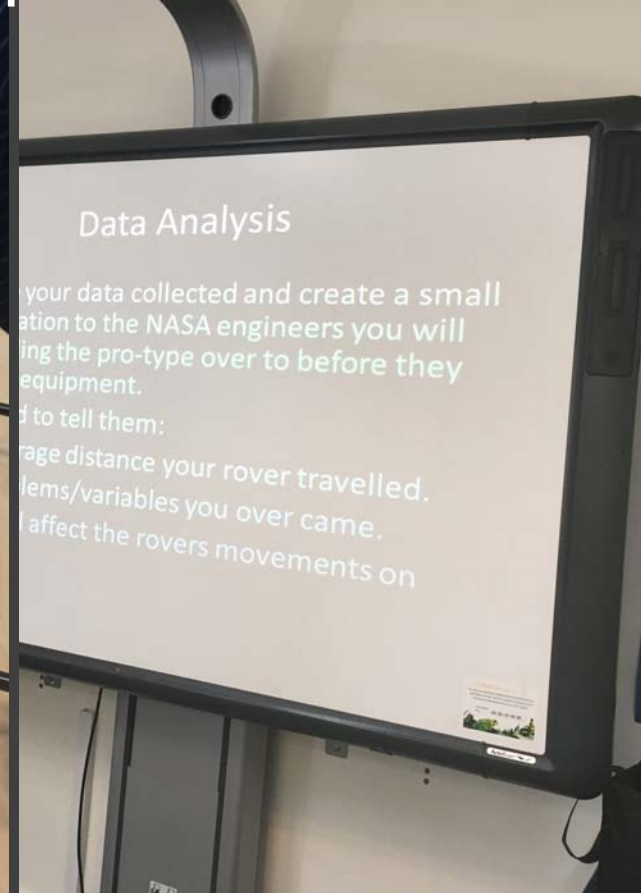
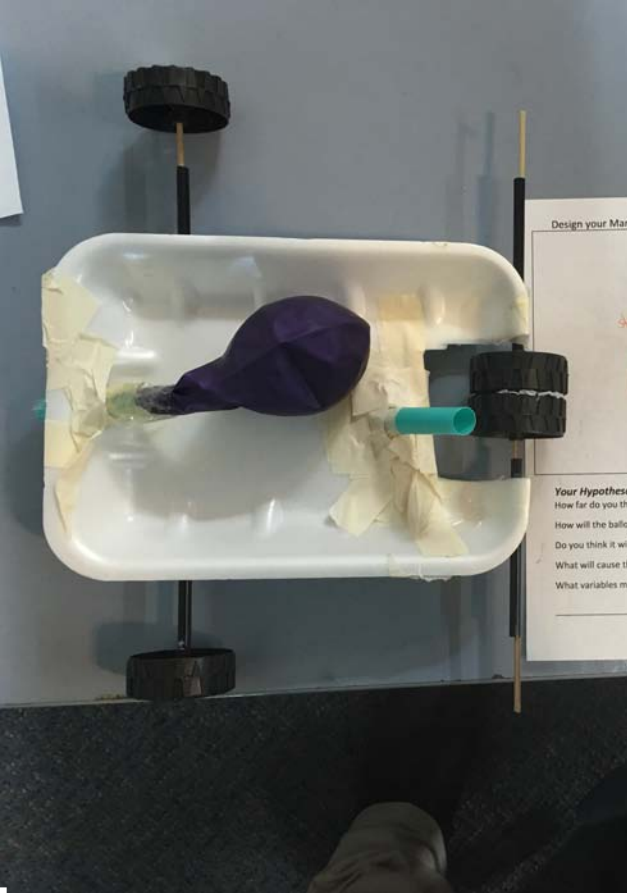
QUESTIONS

- When bees collect pollen where do they keep it?
- How do humans farm honey?
- Why did people always wear WHITE clothing when around bees? Why no other colours?
- Do bees like specific flowers or plants?
- How do bees make honey?
- What do they bring or give to the queen bee?
- Why are bees stripy?
- Can bees only sting one time?
- What are bee hives made out of?
- Why are people allergic to bees?
- Why are bees yellow and black?
- Is there a king bee?
- Is the queen bee bigger than the other bees?
- Are they making the honey for people or the queen bee?
- Can bees see the nectar?
- How can bees communicate?
- How do bees tell the difference between flowers and the pollens?
- Can bees see heatwaves?
- What do bees antennae do?
- Why are bees & furry?

FACTS

- Bees have fur.
- Segment body.
- Lots of bees could be found in farms.
- Bees are really busy.
- There are many types of bees.
- Bees sting people.
- Honey could be great food for people.
- Bees make honey by collecting pollen in flowers.
- People need to wear protective clothing if they are near bees.
- They give us honey.
- Bees live in a hive.
- They only sting once.
- Bees have stripes.
- Bees have 2 large compound eyes.
- Middle leg help bees to walk forwards.
- Six legs.
- Long mouth.
- Have brain.

More formative assessment (Bees, Pollination, and more)



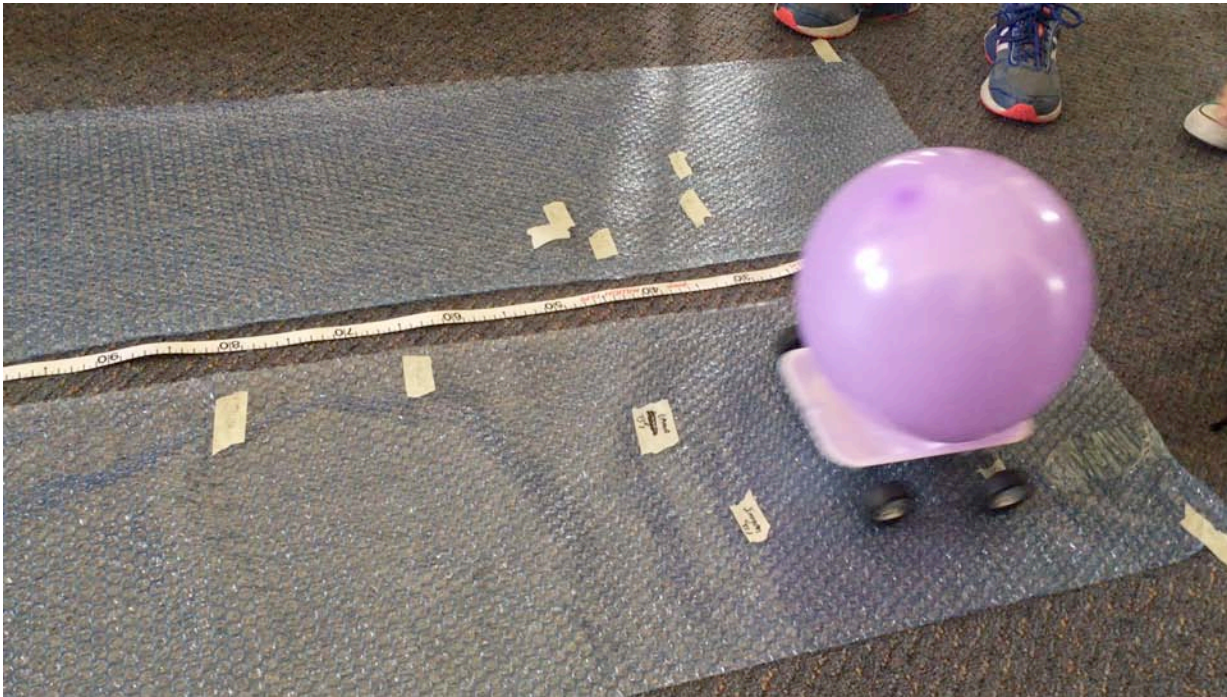
	Best trial on carpet terrain	Bubble wrap trial 1	
n	3.40	P4.00	
ive	3.00	P3.00 1.4	
ay	6.60		
ie	5.40		
ru	2.40	P: 1.00	
on	3.20	0.20	

Team Teaching (Designing, Building and Analysing Mars Rovers)



Researching Integrated STEM

(Designing, Building and Analysing Mars Rovers)





Team Teaching (Coding and Colonisation of Mars)

(On the prepared
template students justify
choice of supplies and the
path the Mars Buggy took
to collect them.)



BEE BOT LIMITATIONS

Cargo bay doors are at the front of the BeeBot so the front of your BeeBot must face the supply drop-zone

Fuel capacity = 100L

- Travel 500m = 2L fuel use
- Turn left or right = 2L fuel use

SUPPLY ZONES

A = Water purification system

D = Solar Panels to make fuel

B = Perchlorate filter

E = Greenhouse to grow food in

C = Insulated human habitat

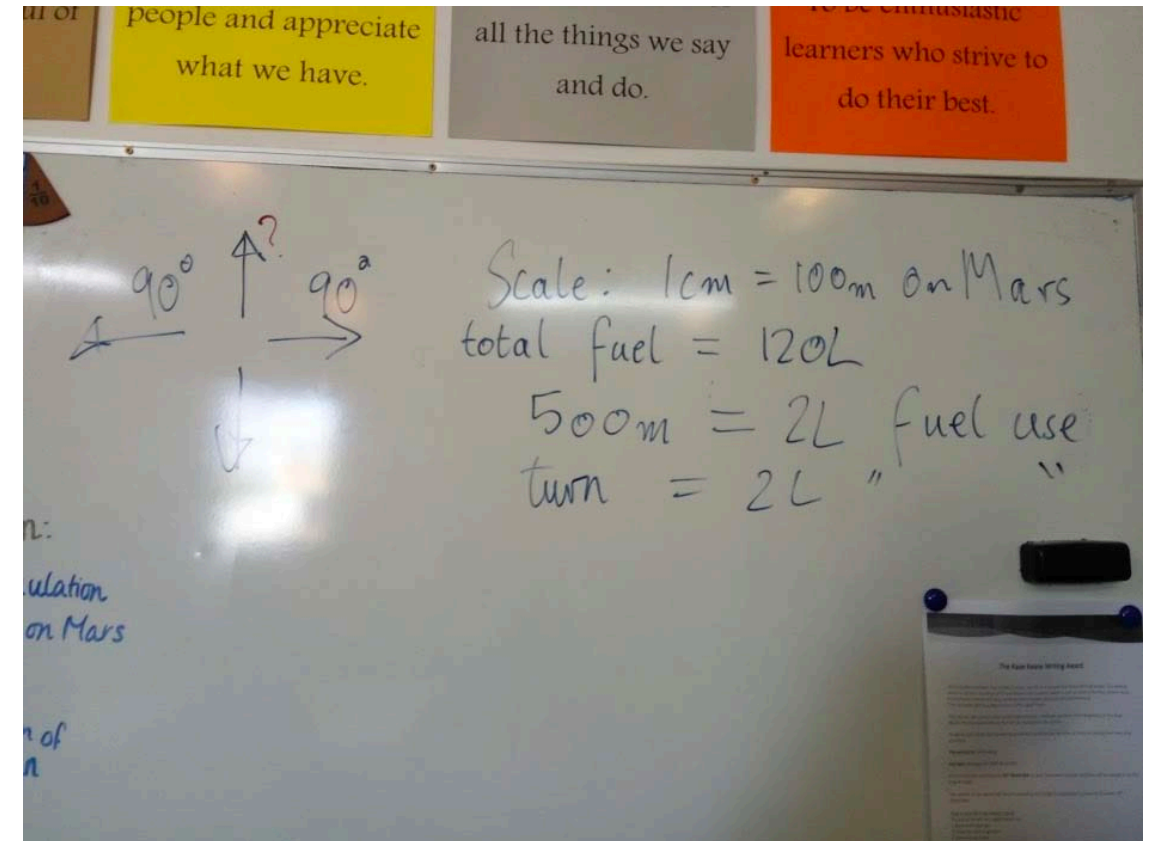
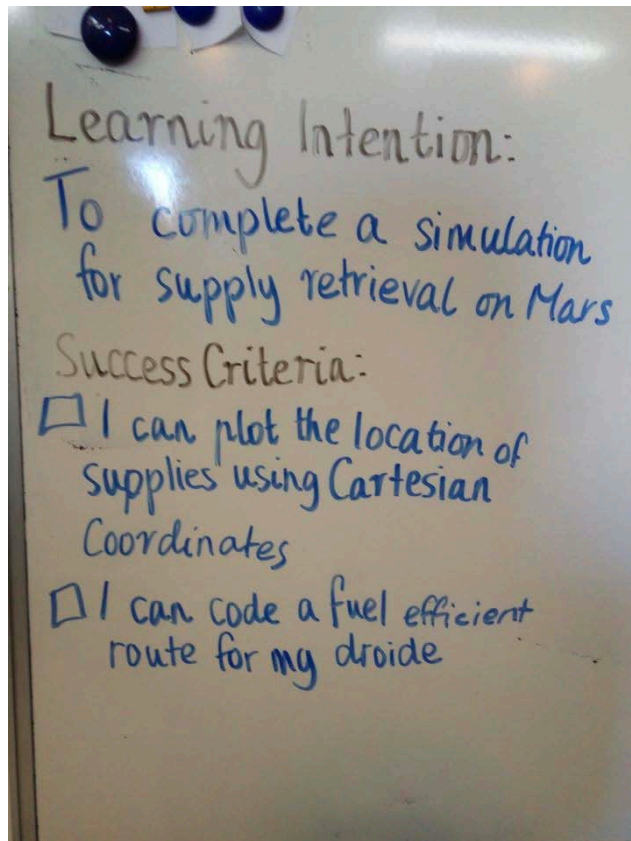
F = Radiation suits

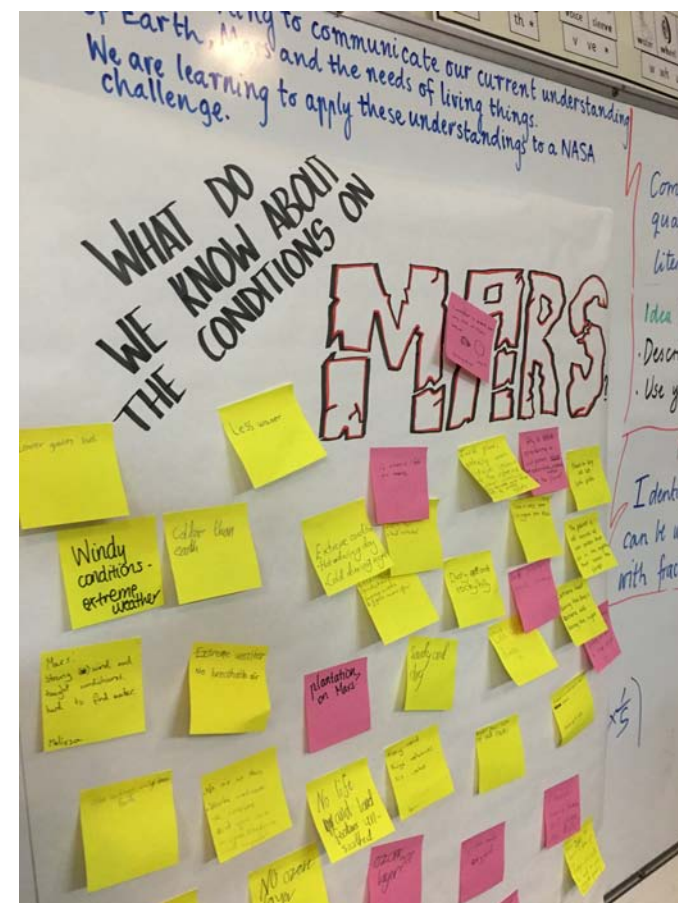
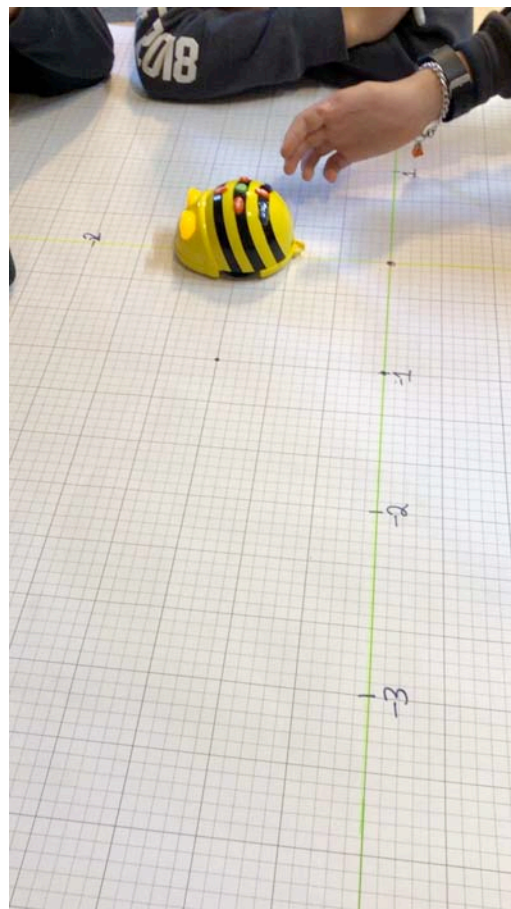
SCALE : 1cm on the map = 100m on Mars

WRITE YOUR ALGORITHM TO COLLECT AND BRING BACK YOUR SUPPLIES

Command	Fuel used by command	Total fuel used	Cartesian coordinate reached

Team Teaching (Coding and Colonisation of Mars)





Reflection

A student referred to the simplicity of Ozobot codes compared to other coding software.

 Add comment

Reflection

All students enjoyed the lesson, showing that they were engaged with the learning goals.

 Add comment

Good extension of student thinking Tyson, showing students how much they have learned and how it all connected (terrains, Cartesian coordinates, and coding)

 Add comment

"Why did you choose that code?"

Josh asking student to justify their thinking.

 Add comment

Students are able to plan and design their solar panels, intersections and infrastructure; but struggling to apply it using Ozobots

 Add comment

"It goes rogue" - Girl in Ulrich's group

 Add comment

Engagement with the lesson is high

All students are on task and collaborating well (except for the one girl who is working by herself haha)

 Add comment

Are the students just making inclines, or creating communities? Needs to link to previous lessons

 Add comment


A common error throughout the lessons were the use of robots. Students are finding it really hard to draw appropriate lines, use distinct colours, be neat. A modelling would have been really good


 Add comment

Taking specific expert roles is a good way of sharing the

Loved the explanation of mountains

2 comments

 Emmanuel Giannopoulos 8mo
Using technical language

 Add comment

 Add comment

Reflections – Post the Lesson - Padlet

Ask students to project their voice, I was at the back of the room and couldn't hear one of the girls.

There was also a student rolling around a bit, ensure the focus and respect if being given to all students when sharing their findings

Add comment

Emmanuel Giannopoulos 8mo

One student kept talking throughout the presentations of students; squash that early on, set high expectations of respect

Add comment

What is becoming more apparent the further this sequence goes is the real need for more lessons for the scope we initially had. It would be so interesting to see how this develops over a whole term.

How can we link the knowledge from the first lesson? What about a lapse in judgement including it?

Add comment

Discussion initially felt a bit forced and unnatural, be real clear with what you want students to talk about. Go through the questions and provide some scaffolding for how you want students to communicate their findings

Add comment

What do you think worked really well? It's worth having a conversation at the end of the lesson to unpack challenges and let students know that hitting barriers is ok, but it's how we work through them that is important

Add comment

Giving each teacher an 'expert role' is a great idea

This allows students to analyse why they have run into a problem and know who to ask

Add comment

Narrative again is extremely engaging, love the use of music

Add comment

Reflection questions - group talk before sharing : a whole class

Good adaptation from last week as all students were able to hear the input from each group. I heard one student say "found today really challenging" showing that they were reflecting on the learning.

Add comment

Adapted well from last week

Much higher scaffolding and less cognitive load. Allows students to engage with the learning goals more effectively

Add comment

There were some groups who didn't have enough members, so maybe modify the group's?

Add comment

narrative was excellent

Students were laughing and highly engaged

Add comment

First group finished

They seem to understand the digital technologies skills they mapped a track across the four quadrants with the usage of a variety of codes.

Add comment

Misconception

seems as though students have a misconception that a tracks need to be straight and only turn at right angles also seems that some students think that they need to colour in the whole squares on the grid paper.

Add comment

Reflections – Post the Lesson - Padlet

Having one student in each quadrant was a great idea

This helps to hold the collaboration process and allow team members to know who is working on which quadrant

Add comment

Applications for your School Setting

Undertaking this approach requires serious resourcing (teacher time and money)

The pedagogical demands for this approach to teaching are also high

We recommend the rigorous and collaborative approach taken in the context provided in this session.

Planning occurred collaboratively with 6 PSTs – three responsible for leading a given lesson and three undertaking observation.

These roles were flipped throughout the process.

Observing participants utilised 'padlet' to create a community for feedback.

Clearly planned and documented approaches to formative assessment are essential.

Big Ideas for starting Collaborative Integrated STEM

- Your Learning Specialist (mathematics, science or STEM) should lead this work and provide both passion and inspiration.
- Leaders will probably need to support them to gain further professional learning in the area
- A driving narrative based on the curriculum that genuinely allows for STEM is required for each sequence.
- Plan for non-tenuous (synergistic) links between disciplines and within disciplines.
- A team of committed teachers prepared to work and learn over the long term is necessary
- Foster a culture of continual professional learning and risk taking in STEM
- Focus on student STEM learning through formative assessment



An Offer...

If your school seriously wants to pursue these ideas contact us...

- Dr Duncan Symons
 - duncan.Symons@unimelb.edu.au
- Dr Max Stephens
 - m.stephens@unimelb.edu.au



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