

Sequence 2 - Focus: Scientific Investigation

Lesson 1:

This lesson sequence was based around a BOSTES mandated scientific investigation assessment (Figure 26), where students were required to design their own experiment to scientifically test what was the best coffee cup to use for a takeaway shop in the area over three lessons in class.

In Lesson 1, the data analysis of student PLP's (Figure 21 & Appendix A, B & C) were used to conclude that a scaffold would be required for learning support students to succeed in undertaking a higher order assessment task of this nature. I first designed the scaffold in consultation with my ST for each lesson (Figures 27, 32 & 37), and then approached the science faculty regarding its implementation. It was well-received and implemented for all learning support students throughout the entire science faculty (Figure 22). During the lesson, I used a range of pre-assessment strategies (Figures 24 & 25) to gain student understanding of the scientific method. Based on this data, further lessons would involve explicit teaching of numeracy strategies. Ultimately, the scaffold had a positive student impact resulting in a high level student response from the learning support students (Figure 28).

As this assessment task requires a large range of assumed knowledge and higher order thinking on the scientific method, it is important that pre-assessment be conducted to ensure students understand the concepts required to be successful. Some important concepts include hypothesis, variables, how to conduct a fair test, and how to collect data. To test these, my ST suggested the use of active learning cards (Figure 24) and an active learning activity called Hot Seat (Figure 25).

Lesson Details				
Teacher Education Student			School	
Lesson duration	55 minutes	Year 8	Period: 1	
Curriculum area	Science	Topic Energy	Date 24/10	
Lesson Title/Focus Coffee cup experiment- planning the investigation				
Syllabus Outcomes collaboratively and individually produces a plan to investigate questions and problems SC4-5WS identify trends, patterns and relationships, and draw conclusions SC4-7WS selects and uses appropriate strategies, understanding and skills to produce creative and plausible solutions to identified problems SC4-8WS presents science ideas, findings and information to a given audience using appropriate scientific language, text types and representations SC4-9WS discusses how scientific understanding and technological developments have contributed to finding solutions to problems involving energy transfers and transformations SC4-11PW				
Lesson Intentions (at the end of this lesson students will...knowledge, skills, attitudes, understandings) <u>Students understand the process of the scientific method and key concepts such as aim, hypothesis, method, variables, control and how to collect data.</u> Assumed knowledge (ie topic, conceptual understandings, language structures and features, literacy, numeracy and ICT skills, previous stage outcomes) Basic knowledge of a scientific report e.g. hypothesis, variables, materials list, method. However, they will be recapped over during this lesson.				
Differentiation I have designed an assessment scaffold that will has been approved for use by all staff across the science faculty with identified learning support students for differentiation.				
Focus for	Literacy Literacy assessment on writing a scientific report	Numeracy Data and units of measurement	ICT Writing report digitally	
Resources and WHS Assessment task, books, laptops.				

Figure 21(a): Lesson plan 1; Sequence 2 - Coffee cup experiment planning.

Teaching and Learning Sequence			
Timing	What teacher does and says	What students do and say	Assessment and feedback strategies
Introduction 5 minutes	<p>Welcome in year 8- form 2 lines outside the class make sure to settle students before entering. Settle them and ask students to sit with their groups.</p> <p>Write up the 5- minute classroom management strategy on the board.</p> <p>On PowerPoint have learning goals for the lesson projected. Tell students about assessment task.</p>	<p>Students enter class in an orderly manner and take their seats.</p> <p>Laptops closed and listening.</p> <p>Students ask questions</p>	Verbal feedback
Body 15 minutes	<p>Run Pre-assessment of student knowledge of scientific method. By using:</p> <p>1) ABCD cards- pre-assessment multiple choice on scientific method concepts</p> <p>2) Hot seat activity- using random name generator- and select students to sit in the hot seat and describe a scientific method concept. If they are correct they win a prize- if not their peers help them.</p>	<p>Students listening and can ask any questions or concerns</p>	<p>Formative pre-assessment to check for current understanding</p> <p>Verbal feedback</p>
10 minutes	<p>After pre-assessment, run over the most important science report principles such as variables e.g. teach mnemonic Cows Moo Softly. Run through risk assessment and picking materials for the experiment.</p>	<p>Students can ask questions or concerns that they have</p>	
20 minutes	<p>Instruct students to complete report from aim up to a completed method section as we start the experiment tomorrow. Hand out differentiated scaffolds.</p> <p>Collect the student coffee cups with names labelled.</p> <p>NOTE any groups without 3 cups in total.</p>	<p>Learning support students working from differentiated scaffold.</p> <p>Students hand in cups</p>	Collect the student work samples and check over for student understanding.
Conclusion 5 minutes	<p>Recap scientific method steps we have covered.</p> <p>Thumbs up or down (formative assessment) to check the number of groups that have completed their method and feel ready to begin the experiment on Wednesday.</p>	<p>Students raise hands</p>	Verbal feedback

General Implications

- Literacy Difficulties
- Dyslexia – Specific learning disorder with impairment in reading, difficulties with word reading accuracy, rate/fluency
- Possible impairment in written expression
- Can speak Italian
- Reading recovery
- NAPLAN 2014: Band 4 – Writing and Spelling
- Spelling Mastery B; Decoding B2 programs completed in Junior School

Class Implications

- Encourage reading, but be aware he may need advance warning before being asked to read out loud
- Provide assistance – such as vocabulary lists to assist with extended written responses
- Accompany written directions with explicit spoken instruction
- Needs more time to read questions or task instructions before he starts the task itself
- Will require more time to write his answers
- Sometimes allow [REDACTED] to answer questions verbally rather than writing them down
- [REDACTED] would benefit from more time to complete exams not specifically testing reading
- Reduce [REDACTED] written work so that quality rather than quantity is measured
- Special Provisions for all exam blocks in Learning Support
- Attends Literacy Lessons in Learning Support, Please see [REDACTED] if issues arise.

Figure 22: Student PLP

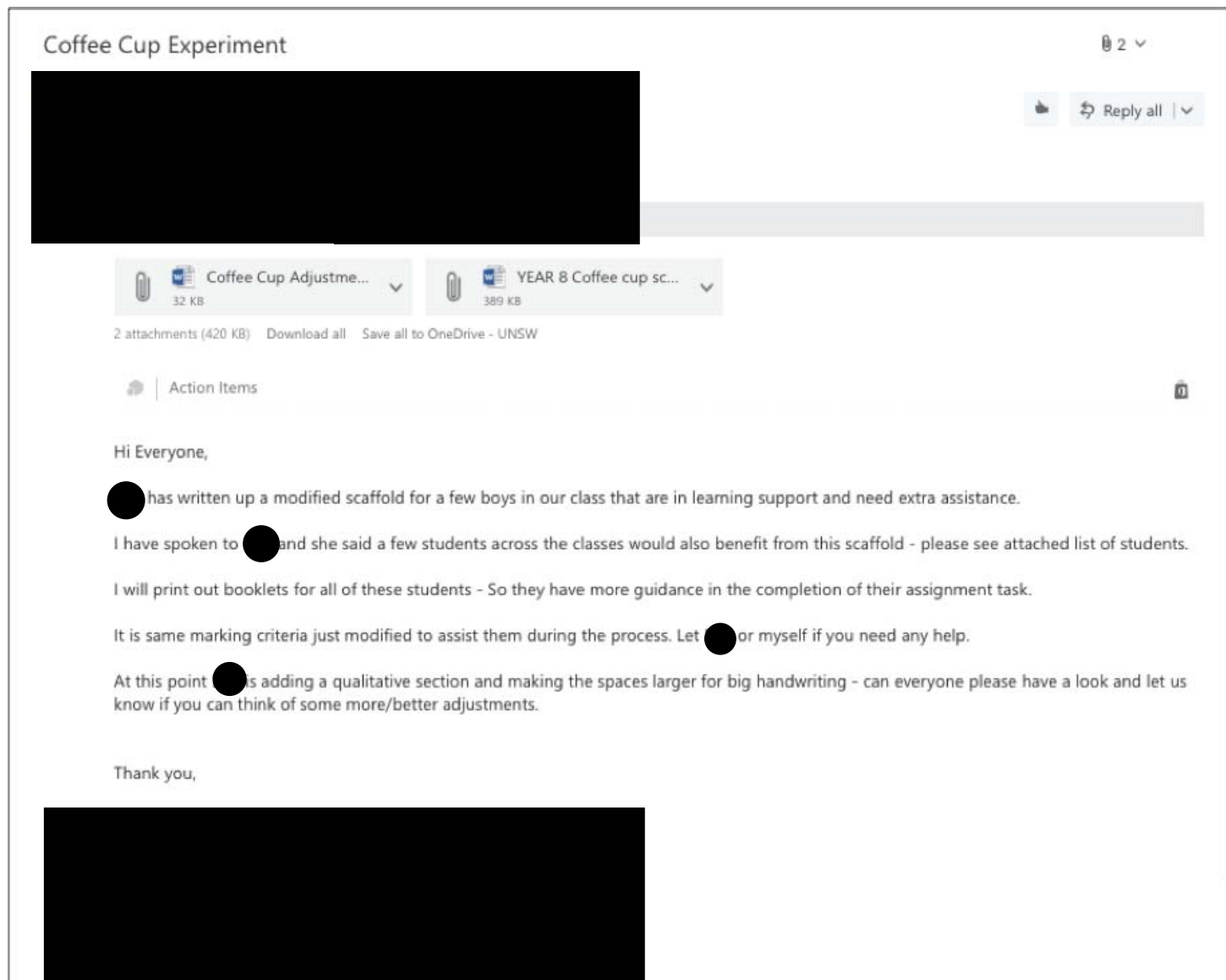


Figure 23: Evidence- email confirming the use of the scaffold for learning support students.

The scaffold (Figure 27) was ultimately utilised for sixteen learning support students across the entire Year 8 cohort. Five of these students were in my Year 8 class.



Figure 24: ABCD cards - Formative Pre-assessment

Activity: involved a range of multiple choice questions asked on scientific method concepts .

These included concepts such as:

- What is a hypothesis?
- Identify the Independent, dependent and controls.

Students then raised their cards in the air. This is an effective formative assessment that increases the rate of opportunities to respond (Simonsen, Myers & Deluca, 2010) and quickly identifies students prior knowledge visually to the teacher.



Figure 25: Random name generator used during Hot Seat activity

Activity: A random name generator was used to select student at random. They then came to the front and sat in a chair (the hot seat). A scientific word was asked and they had to explain it's meaning. For example "what is the independent?" "It's the thing you change!". According to Regier (2012), this is a quick, effective and engaging formative assessment for student concept understanding.

THE TASK

- You have been asked by the local coffee shop to determine what is the best takeaway coffee cup to be used.
- You will need to determine the variables you think would qualify a coffee cup as 'the best'.
- You will need to design and carry out an investigation to test your chosen variables and present your findings in the form of a written report.
- You will work in pairs over three lessons in class to undertake the practical task.
- You will submit an **individual report**. You will have TWO lessons in class time and may use your own time to finish the task.

Note: You will need to purchase different takeaway coffee cups for use in the experiment. It is important to take note of the cost of the purchase of the cups as this may be important for your investigation.
The school will provide your group with only ONE type of Styrofoam takeaway coffee cup.

WHAT TO HAND IN:

Write a scientific report for your investigation – a planner/scaffold is provided on the last page of this document.

- Your final scientific report must include the following headings:
 - Title
 - Aim(s)
 - Hypothesis
 - Risk Assessment and safety precautions
 - Experimental Variables
 - Equipment List
 - Method
 - Results & Data – tables and graph should be included here
 - Discussion and Evaluation
 - Conclusion

SCIENCE REPORT SCAFFOLD

Scaffold	Notes
Title	This is where you describe your investigation in a simple sentence.
Aim e.g. To determine the effect of UV light on the rate of growth of mould on bread	Communicate what your investigation is about i.e. the aim should include: the effect, the independent variable and the dependent variable.
Hypothesis	An hypothesis is a statement that describes a relationship between two or more variables that can be tested. Example: If the independent variable is (increased, decreased, changed), then the dependent variable will (increase, decrease, change.) Hypothesis: If the amount of sunlight is increased then there is an increase in the height of wheat plants.
Experimental Variables	State the Independent variable (what is purposely changed) State the Dependent variable (what is measured) Controlled variables (what is kept the same)
Method	Describe how you conducted your investigation mentioning all appropriate variables and controls, the materials and any technologies you used. Write the method as a procedural recount for the steps that you followed in order to collect data. A procedural recount is written in the past tense.
Results	Report the results you observed for the procedure. Present average values (from number of trials or number of samples) rather than every measurement that was made. Use tables and graphs where appropriate. Do not interpret the results in this section. Do that in the Discussion section.
Discussion and Evaluation	This section includes an assessment of the results (trends and patterns) of your investigation. You should provide plausible explanations for your findings. An outline of experimental design improvements must also be discussed in this section. You should also outline any problems encountered and how these were addressed.
Conclusion	This section includes ideas on what your results suggest the answer is to your hypothesis. Conclude how well the results supported your hypothesis.

Figure 26: Original assessment task

The nature of this task is highly challenging. To be successful, the design of a scientific investigation requires a solid understanding of the scientific method and higher order thinking to apply the scientific method to design a fair test. This high level of understanding required was the justification behind designing the scaffold for learning support students below (Figure 27).

WHICH COFFEE CUP IS THE BEST?



You've just opened up a small coffee shop in Waverley and have a long list of loyal customers who grab coffee on their way to work.

To improve your business, you've asked them for feedback. While they love your coffee, a few complain that their coffee gets cold too quickly. They suggest that it is because of your coffee cup material.

Your job now is to determine the best coffee cup to use.

LESSON OUTLINE FOR YOUR PROJECT:

Lesson	What to do	Page/s	Done?
1	Title, Aim, Hypothesis, Variables and step-by-step Method	2-3	<input type="checkbox"/>
2	Follow your method to do your experiment and record Results	4-5	<input type="checkbox"/>
3	Conclusion and Discussion	6	<input type="checkbox"/>

IMPORTANT:

- ❖ After each lesson, GIVE YOUR BOOKLET TO YOUR TEACHER.
- ❖ Feel free to use the back page of this booklet to jot down ideas or notes!

LESSON 1:

Start writing up your experimental report
This page and the next page

Title of your experiment:

Aim: (what am I trying to find out?)

Hypothesis: (what I think will happen)

Risk assessment: (Safety precautions)

Equipment list:

- 3 different kinds of cups (e.g. paper, foam and plastic)
- 3 thermometers
- electric kettle (and water)
- stopwatch
- measuring cylinder

Independent Variable: (the ONE factor you change on purpose)

Dependent Variable: (what is the thing that I will record?)

Controlled Variables: (factors that MUST be kept the same)

- _____
- _____
- _____
- _____

Method: (your detailed step-by-step instructions in past tense).

1.



According to Sweller & Kalyugur (2011) scaffolding is pertinent in reducing a student's cognitive load. Reducing the cognitive load will make learning more manageable for a student already struggling with other overwhelming aspects of the task increasing student achievement improving overall learning achievement.

Figure 27: The scaffold for learning support students

LESSON 1:

Start writing up your experimental report
This page and the next page

Title of your experiment: Which coffee cup is the best

Aim: (what am I trying to find out?)
Which cup holds the temperature of the hot water longer.

Hypothesis: (what I think will happen)
The cup made ~~out~~ out of thick cardboard will keep the water hotter for longer

Risk assessment: (Safety precautions)
The safety precautions were if the hot water split on you, that would lead to a nasty burn so you had to wear a tea towel.

Equipment list:

- 3 different kinds of cups (e.g. paper, foam and plastic)
- 3 thermometers
- electric kettle (and water)
- stopwatch
- measuring cylinder

Independent Variable: (the ONE factor you change on purpose)
The Independent Variables were each ~~time~~ time we changed the cups. Each cup was about the same size, but made out of different materials

Dependent Variable: (what is the thing that I will record?)
The Dependent variable was the stop watch also, what the temperature was in each cup every ~~that~~ one minute. From the regression the thermometers.

Controlled Variables: (factors that MUST be kept the same)

- Boiling water at the same temperature.
- Filled each cup up to the same point.
- Stop watch started at same time.
- Time temperature was recorded.

Method: (your detailed step-by-step instructions in past tense).

1. We placed three cups of different materials on the bench yellow thick cardboard, white polystyrene, thin cardboard.
2. Boiling water was poured into the measuring beaker.
3. We poured water from the beaker into each cup up to the same level.
4. Then we recorded the temperature in each cup started the stop watch
5. stopped the watch at 1 minute and again recorded the temperature.
6. we repeated this at 2, 3, 4, 5 minutes.

Student impact:

During this lesson, the entirety of the work was completed to a high level by the LP student - an extremely pleasing result. In some of the previous lessons, work output has been zero. Therefore, the scaffold had an impact in student response quality.

Figure 28: Assessment scaffold for learning support students example.

5. Teachers assess, provide feedback and report on student learning

Engaging pre-assessment activities on scientific report principles. The ABCD cards gave a quick visual of what concepts students knew. E.g. majority of students knew what a hypothesis was but majority were confused on graphing and quantitative vs qualitative. The hot seat activity was well received and the class was super engaged. A number of problem areas students were not sure on were identified in numeracy.

General comments (including evidence of continually improving professional knowledge and practice, ability to respond constructively to the advice and feedback of colleagues and commitment to being actively engaged in the profession and wider community)

An excellent lesson [REDACTED] approached the science faculty about designing a support scaffold for learning support students within Science for the BOSTES mandated assessment which contains higher order thinking. This has resulted in many of the learning support students failing the task or having a non-attempt in previous years. [REDACTED] scaffold has been very well received by both the students in his class today. The science faculty as a whole and the learning support staff have all had positive feedback. [REDACTED] is actively trying to differentiate and support all students in this highly varied ability class.

Recommendation for next time

Based off pre-assessment- next lesson add in numeracy techniques to help the students understand graphs.

Figure 29: Teacher Observation Feedback

Sequence 2 - Focus: Scientific Investigation

Lesson 2: Literacy and numeracy strategy: Designing a scientific report and scaffold of tables

In Lesson 2, students finished collecting data during a practical lesson and then used the results to create a graph for their reports. A numeracy strategy was implemented where mini whiteboards were by the students were they graphed their results set and then held up the boards so the teacher could assess student understanding (Figure 31). A scaffold of the graph was also created for learning support students (Figure 32), and an ICT strategy was used to help generate graphs for students that required more help (Figure 33). The lesson plan can be observed in Figure 30, and the teacher observation feedback is in Figure 34.

Lesson Details					
Teacher Education Student				School	
Lesson duration	55 minutes	Year 8	Period: 2		
Curriculum area	Science	Topic Energy	Date 26/10		
Lesson Title/Focus Coffee cup assessment- practical and results collection					
Syllabus Outcomes					
collaboratively and individually produces a plan to investigate questions and problems SC4-5WS					
identify trends, patterns and relationships, and draw conclusions SC4-7WS					
selects and uses appropriate strategies, understanding and skills to produce creative and plausible solutions to identified problems SC4-8WS					
presents science ideas, findings and information to a given audience using appropriate scientific language, text types and representations SC4-9WS					
discusses how scientific understanding and technological developments have contributed to finding solutions to problems involving energy transfers and transformations SC4-11PW					
Lesson Intentions (at the end of this lesson students will...knowledge, skills, attitudes, understandings)					
Students are to understand how to collect and graph the data for the results section of their scientific investigation					
Assumed knowledge (ie topic, conceptual understandings, language structures and features, literacy, numeracy and ICT skills, previous stage outcomes)					
Basic knowledge of a results table and how to construct a column graph- however they will be re-taught depending on the results of formative assessment of graphs using mini whiteboards.					
Differentiation					
I have designed an assessment scaffold that will be used by all staff across the science faculty with identified learning support students for differentiation.					
Focus for	Literacy Literacy assessment on writing a scientific report	Numeracy Data and units of measurement	ICT Writing report digitally		
Resources and WHS					
Assessment task, books, laptops.					

Figure 30(a): Lesson 2; Sequence 2 - Numeracy Strategy for Graphing

Teaching and Learning Sequence			
Timing	What teacher does and says	What students do and say	Assessment and feedback strategies
Introduction	Welcome in year 8- form 2 lines outside the class make sure to settle students before entering. Instruct students to sit with their groups.	Students enter class in an orderly manner and take their seats.	Verbal feedback
5 minutes	Write up the 5- minute classroom management strategy on the board. On PowerPoint have learning goals for the lesson projected. Go over safety and safety demo, results table drawing and experiment goals for the lesson.	Laptops closed and listening. Students listening and can ask any questions or concerns	
Body	Safety talk and demo correct handling of boiling water with students. Consequence- if acting dangerously they will sit and complete report for the rest of lesson.	Students listening and can ask any questions or concerns	
5 minutes	Using worked example of excel table scaffold to show students how to collect experiment data. Check student results collection strategy before they collect equipment.	Students can ask questions or concerns that they have	Check students work samples
20 minutes	Circulate throughout groups conducting experiment helping them and aiding when necessary. Students are to pack away equipment.	Students hand in cups	
20 minutes	With mini whiteboards- students are to draw their data <u>Students complete quick feedback survey regarding teaching and learning in the past 3 weeks- questions relate to standards on GTPA.</u>	Students complete survey	
Conclusion			
5 minutes	Thumbs up or down (formative assessment) to check number of groups that completed their results and understand how to complete their results section.	Students raise thumbs. Students hand in their work for the lesson to be checked by the teacher.	Check through student work samples for understanding and to inform future teaching.

Figure 30(b): Lesson 2; Sequence 2 - Numeracy Strategy for Graphing

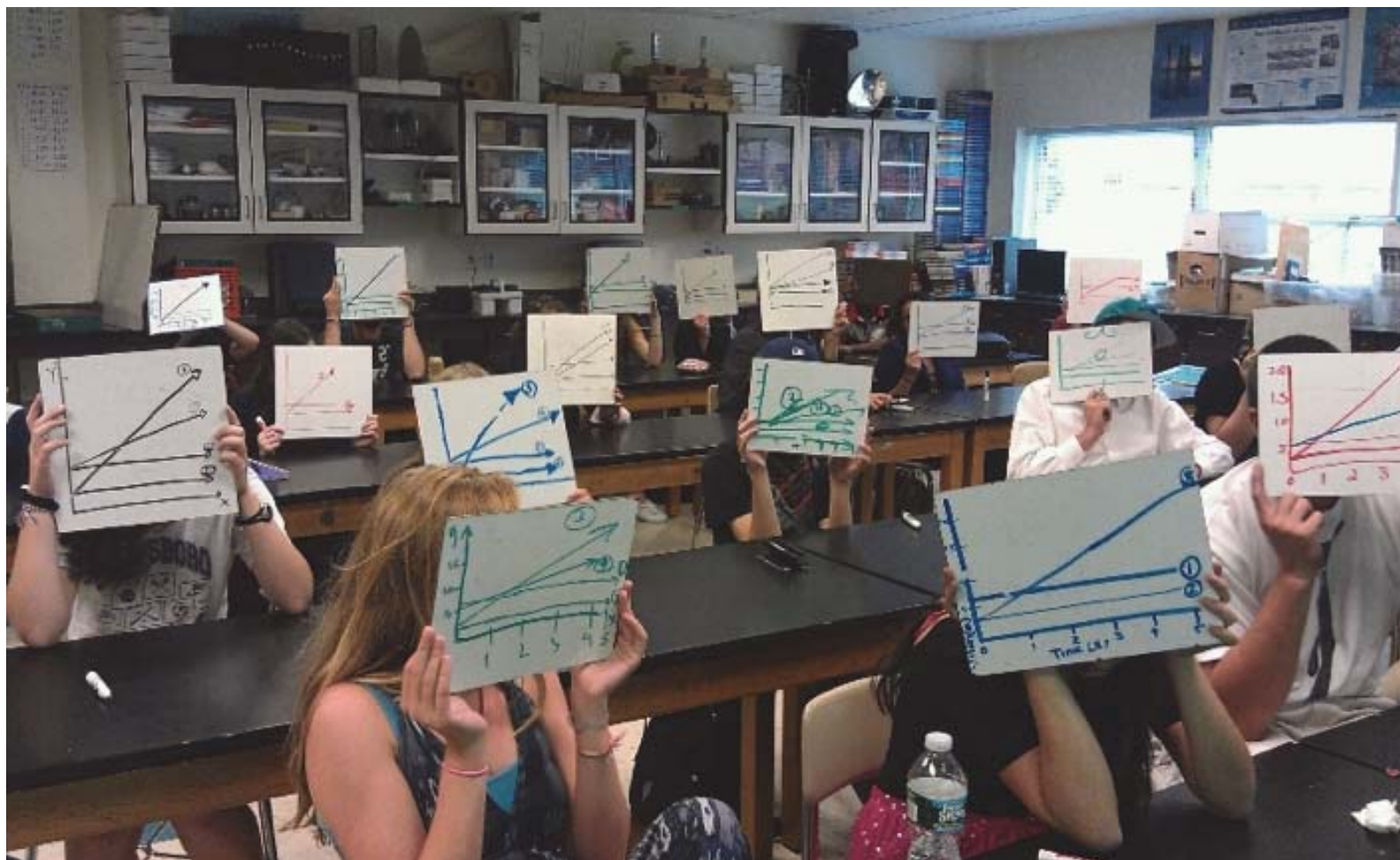


Figure 31: (NOTE: this is not my own image but is used to illustrate an identical process that was implemented during my lesson).

The use of mini whiteboards allowed a greater opportunity of student responses and was an effective formative assessment to immediately visualise the class understanding of graphs.

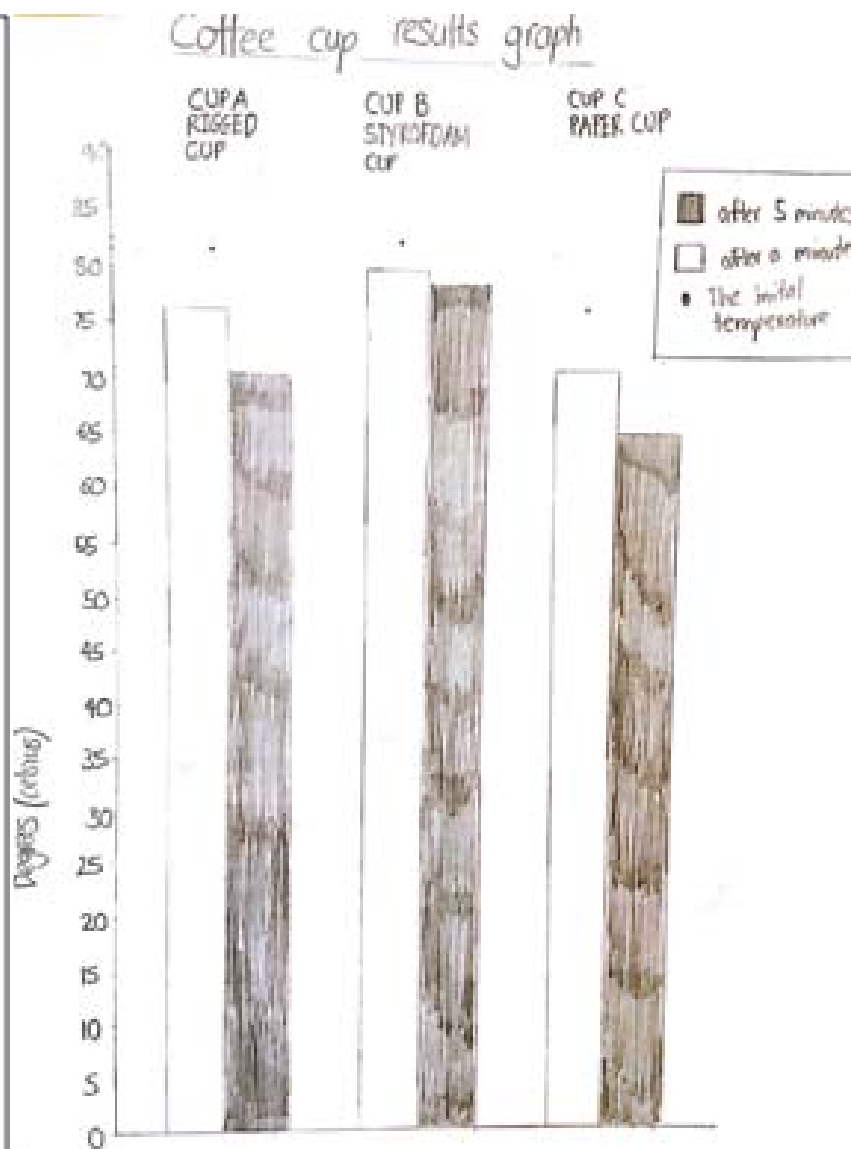
William & Leahy (2015) posit the use of mini whiteboards as an effective formative assessment. Used in conjunction with numeracy activities such as this are an immediate visual of what the class needs help on. Data from this activity was used to inform planning for Lesson 3 (Figure 38).

LESSON 2:
DO your experiment and record results in a TABLE and a GRAPH
This page and the next page

Results (qualitative- observations)

Results Table: (quantitative- draw a ruled and labeled table and enter your results here)

Page 4 of 8



Student impact:

Scaffold allowed the LS student to develop a graph due to scaffolding of the scale and axis.

The graph is graded as 3/5 marks but in contrast, many students without the scaffold had zero output in graphing.

Figure 32: Scaffold created for learning support student sample - excellent attempt by learning support student at the graph.

Note: Results section was left empty, as there was not enough time to glue in their tables during the lesson. However, it should be a graph of temperature difference, and the title and axis labels need correcting in Lesson 3.

CREATE A GRAPH

Help



Graphs and charts are great because they communicate information visually. For this reason, graphs are often used in newspapers, magazines and businesses around the world.

NCES constantly uses graphs and charts in our publications and on the web. Sometimes, complicated information is difficult to understand and needs an illustration. Graphs or charts can help impress people by getting your point across quickly and visually.

Here you will find five different graphs and charts for you to consider. Not sure about which graph to use? Confused between bar graphs and pie charts? Read our:



[Create A Graph Tutorial](#)

Examples

Bar



Line



Area



Pie



XY



Direction: ☒ Vertical ☐ Horizontal ☐ True 3D
☐ Stacked ☐ Stacked

Shape: ☒ Rectangle ☐ Cylinder ☐ Triangle
☐ Rhombus ☐ Pattern

Style: Background Color:
 Grid Color: Grid Lines: 6
 Appearance: 2D Legend: position right

Design

Data

Labels

Preview

Print / Save

Start Over

Update

If you wish to revisit this graph, you will need to [bookmark this page](#), or [email yourself](#) this graph.

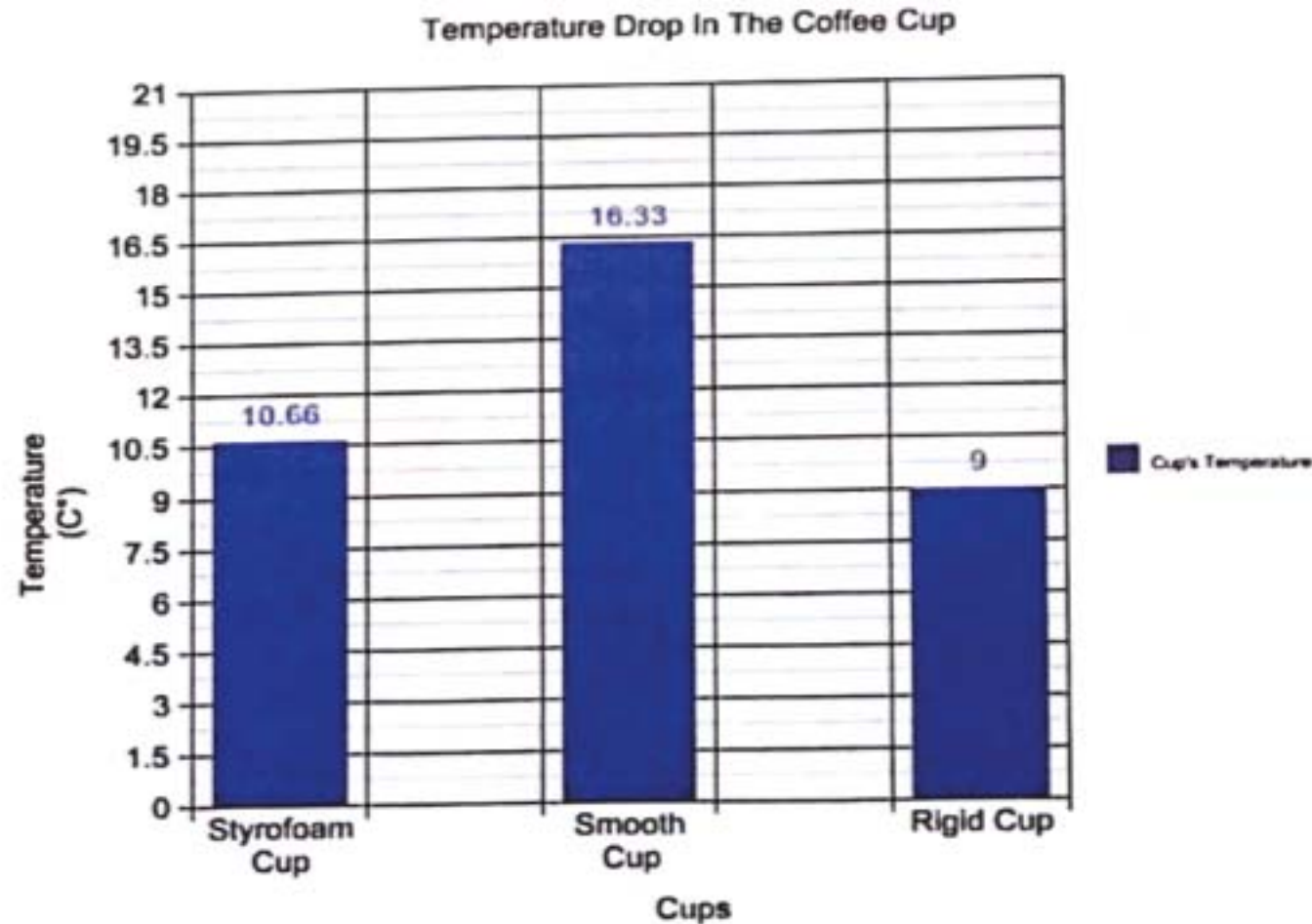
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Figure 33(a): ICT tool - Create a Graph

Graph:



Harish et. al., 2013 found that the use of ICT to teach science had an effect on increasing engagement in science. This activity guides students step by step in the making of a graph based on data they have acquired.

Figure 33(b): ICT tool - Create a Graph

Students struggling with the use of excel were either able to draw their table or were guided through the graph with this ICT tool which guides students in creating a graph based on their data set.

General comments *(including evidence of continually improving professional knowledge and practice, ability to respond constructively to the advice and feedback of colleagues and commitment to being actively engaged in the profession and wider community)*

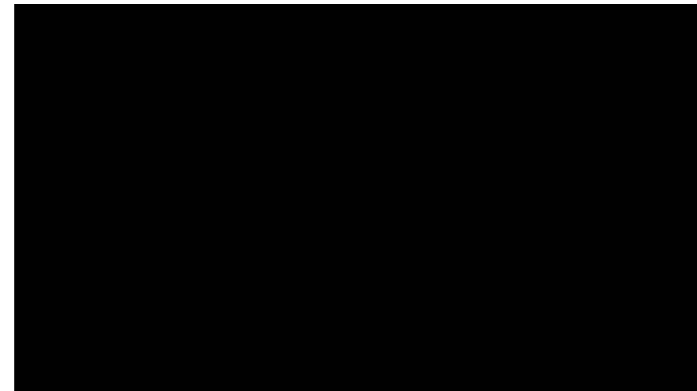
Classroom management- Excellent improvement in control on classroom management this lesson. Took on advice for CM during practicals- making sure all students are silent and completely settled- two lines before entering. You also used a starter activity on graphs so they immediately have something to do focus on upon entering the classroom. You are starting to establish a routine and effective use of 3,2,1, count down for silence (verbal/non-verbal communication).

Use of mini whiteboards for the graphing section was an effective formative assessment

Recommendation for next time

Make a scaffold for some students for next lesson that are still having trouble with the graphs based on the mini white-board formative assessment.

Figure 34: Teacher Observation Feedback



Sequence 2 - Focus: Scientific Investigation

Lesson 3:

In this lesson, based on the formative assessment of mini white boards in the previous lesson, it was clear that many students were still struggling with the creation of graphs. Therefore, an excel spreadsheet scaffold was created to allow students to input their data to generate their column graphs. Students also used the traffic light cards (Figure 36) and moved into ability groups based on how confident they were in finishing their reports conclusion/ discussion session. The student samples can be seen in Figures 37-40. The lesson plan can be observed in Figure 35, and the Mentor Feedback for this lesson is in Figure 41.

Lesson Details					
Teacher				School	
Education Student					
Lesson duration	50 minutes	Year 8	Period: 4		
Curriculum area	Science	Topic Energy	Date 27/10		
Lesson Title/Focus Coffee cup assessment- Final theory lesson					
Syllabus Outcomes					
collaboratively and individually produces a plan to investigate questions and problems SC4-5WS					
identify trends, patterns and relationships, and draw conclusions SC4-7WS					
selects and uses appropriate strategies, understanding and skills to produce creative and plausible solutions to identified problems SC4-8WS					
presents science ideas, findings and information to a given audience using appropriate scientific language, text types and representations SC4-9WS					
discusses how scientific understanding and technological developments have contributed to finding solutions to problems involving energy transfers and transformations SC4-11PW					
Lesson Intentions (at the end of this lesson students will...knowledge, skills, attitudes, understandings)					
Students are to have an understanding of how to write a scientific investigation report to successfully complete all sections of the summative assessment.					
Assumed knowledge (ie topic, conceptual understandings, language structures and features, literacy, numeracy and ICT skills, previous stage outcomes)					
Basic knowledge of a scientific report e.g. hypothesis, variables, materials list, method, results, discussion, conclusion.					
Differentiation					
I have designed an assessment scaffold that will be used by all staff across the science faculty with identified learning support students for differentiation.					
Excel scaffold for data and graphing					
Focus for	Literacy Literacy assessment on writing a scientific report	Numeracy Data and units of measurement	ICT Writing report digitally		
Resources and WHS					
Assessment task, books, laptops.					

Figure 35(a): Lesson 3; Sequence 2.

Teaching and Learning Sequence			
Timing	What teacher does and says	What students do and say	Assessment and feedback strategies
Introduction 5 minutes	<p>Welcome in year 8- form 2 lines outside the class make sure to settle students before entering. Settle them and ask students to sit with their groups.</p> <p>Write up the 5- minute classroom management strategy on the board.</p> <p>Starter questions on graphs on the screen e.g. what is the dependent variable in this graph?</p> <p>Project learning goals on the board for the lesson.</p>	<p>Students enter class in an orderly manner and take their seats.</p> <p>Laptops closed and listening.</p> <p>Students answer then discussion on starter question answers</p> <p>Students write in diaries the due dates and details of the submission.</p>	<p>Verbal feedback</p> <p>Feedback</p>
Body 5 minutes	Instruct students hold up the traffic light cards- green, red, yellow based off of how confident they feel about the results- graphing and discussion/ conclusion section of the report.	Students move into ability groups depending on the level of help they feel that they need. E.g. red group will work with the teacher directly in the construction of their graphs. Yellow group use the excel scaffold independently with aid from the teacher- Green group that have finished move onto discussion/ conclusion.	Traffic light card- formative assessment strategy
10 minutes	Based on formative assessment data (mini whiteboards- last lesson) instruct students an excel results scaffold has been created to help them construct graphs. Demonstrate how to use the excel scaffold on the projector screen.	Students use the excel sheet and ask questions on any difficulties they may have.	Check students work samples
25 minutes	<p>Students work on the discussion/ conclusion section of their reports.</p> <p>Provide information on qualitative variable and explain using worked examples e.g. recyclability of the cup may be a qualitative factor.</p>	Students are to complete discussion/ conclusion.	
Conclusion 5 minutes	Recap the due date and the key concepts of the results/ discussion section we have covered in todays lesson. Thumbs up/ down (formative assessment) ask students if they now feel confident to complete the report	Class listening and participate in discussion.	The final report due in based on all work over the previous 3 lessons will be marked and student results analysed for impact on student learning.

Figure 35(b): Lesson 3; Sequence 2.



Figure 36: Traffic light cards used for ability grouping.

Ireson & Hallam (2001) have found that ability grouping can boost engagement and learning outcomes for students as students can learn at their appropriate level with less apprehensive to asking questions suitable to their understanding.

LESSON 3:

Write an informative CONCLUSION and answer DISCUSSION questions
This page only

Conclusion: (Summarise your results and describe how they meet your Aim)

Discussion:

a) Justify whether your results support your hypothesis.

b) Explain a problem/error that occurred and how this may have affected your results.

c) Describe how to improve your experiment to prevent/minimise errors. Also mention what your next step might be in the quest for finding the best coffee cup.

LESSON 3:

Write an informative CONCLUSION and answer DISCUSSION questions
This page only

Conclusion: (Summarise your results and describe how they meet your Aim)

My results show that ~~both~~ cup 2 ~~and cup 3~~
kept the water the hottest for the
longest. Cup 1 and 3 temp decreased
by a 6° over 5 min. Where as cup 2 temp only
decreased by 7°.

Discussion:

a) Justify whether your results support your hypothesis.

My Hypothesis was different to my
results as I thought the thick
cardboard ~~cup~~ cup would be the
best. my results show it was the styrofoam

b) Explain a problem/error that occurred and how this may have affected your results.

The hardest thing was trying to measure
the temp of each cup every minute
and get a accurate result.

Figure 37: Conclusion/ Discussion scaffold for lesson 3 and learning support student work sample.

The student impact of the scaffold resulted in completion of the work. This learning support student was able to successfully complete the entire report within the 3 class lessons.

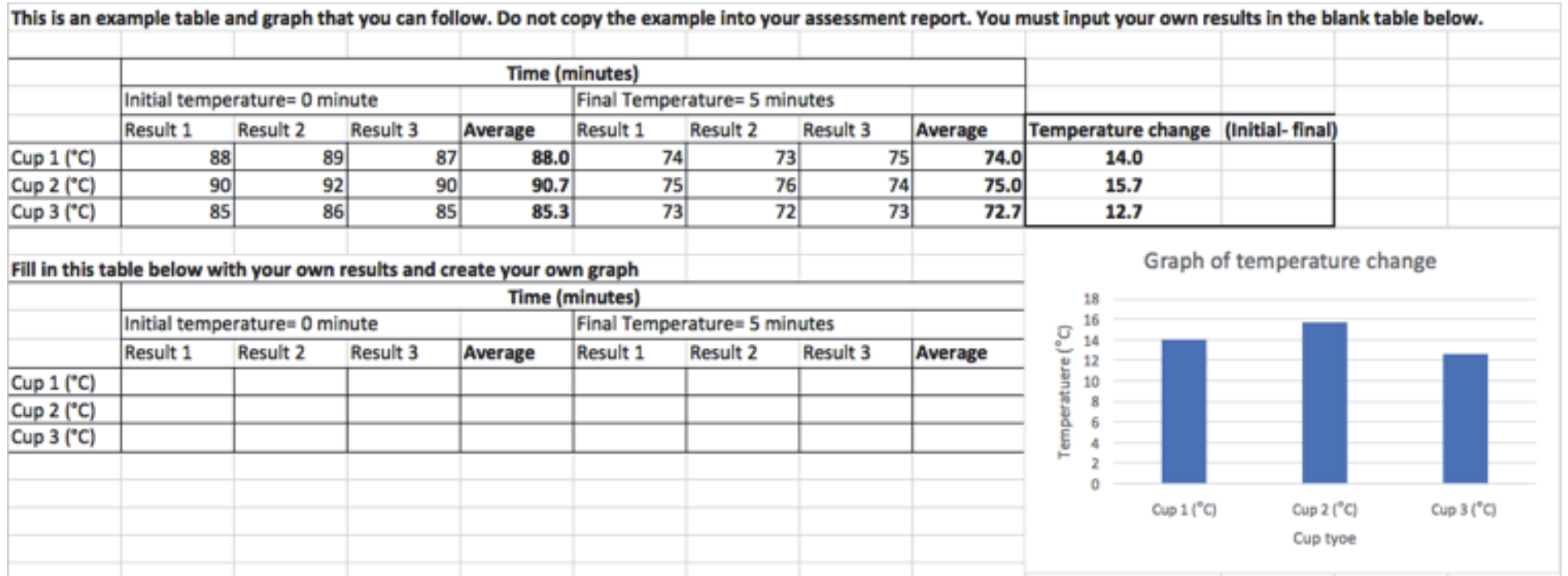
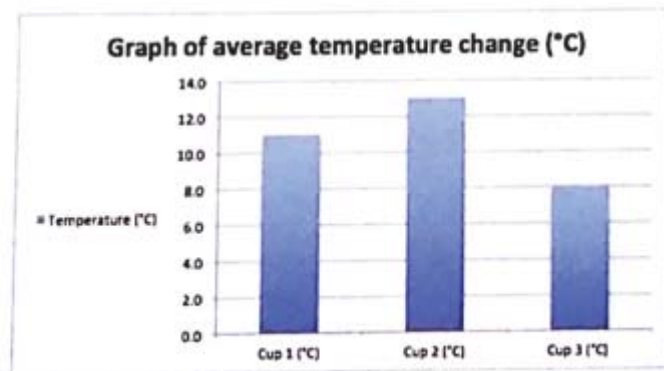


Figure 38: Excel scaffold created based upon low student ability in graphing with formative assessment on whiteboards in lesson 2.

Students can fill in the table scaffold with their data to calculate their results.

Initial heat	80 degrees celsius	89 degrees celsius	70 degrees celsius
1	76 degrees celsius	85 degrees celsius	67 degrees celsius
2	73 degrees celsius	81 degrees celsius	65 degrees celsius
3	71 degrees celsius	78 degrees celsius	64 degrees celsius
4	68 degrees celsius	76 degrees celsius	62 degrees celsius
5	66 degrees celsius	74 degrees celsius	60 degrees celsius
Temperature difference	14 degrees	15 degrees	10 degrees

	Initial temperature= 0 minute				Final Temperature= 5 minutes				Temperature change (Initial-final)
	Result 1	Result 2	Result 3	Average	Result 1	Result 2	Result 3	Average	
p 1 (°C)	67	77	80	74.7	58	67	66	63.7	11.0
p 2 (°C)	83	62	89	78.0	67	54	74	65.0	13.0
p 3 (°C)	71	52	70	64.3	62	47	60	56.3	8.0



Discussion and evaluation

The temperature of the water in all three cups dropped over time (as expected). In all three attempts, Cup 3 performed well compared to the other two cups. However, the performance of each cup was different during each attempt. This could be because we did not control the starting temperature. We could improve this experiment by making sure that each time we attempt the experiment we start with water of the same temperature in each cup.

We thought that we were putting roughly the same amount of water in each cup, but we didn't measure it. If we were to repeat the experiment, we would measure the volume of water with a beaker or a measuring cylinder.

Hattie (2009) found that use of worked examples have a significant impact on student learning achievement. A worked example of an excel graph was first provided. Students then entered their data into a scaffold to create their own graph.

Student impact: A large number of students were able to successfully create graphs in their reports based on this method in contrast to lesson 2 where they had not met this goal.

Figure 39: Student sample of graph that was created using the excel scaffold based upon student data.
This student's graph was awarded 5/5 based upon the marking criteria.

Finding The Most Efficient Coffee Cup

Aim: In my experiment i am going to find the most efficient cup taking in variables such as heat resistance and recyclability.

Hypothesis: I believe that the cup that has the ridges on the outside will insulate the best as it has an extra layer of cardboard. I believe that the styrofoam cup will be the worst insulator as it has a lot of air in between.

Risk Assessment: Some of the risks involved include; Spilling the hot water and getting burnt, spilling water on the electrical outlets, breaking the thermometer and spilling the water on other people.

Equipment List:

- Thermometer
- Kettle
- Coffee cups
- Water
- Laptop

Variables:

Independent: Using different cups to check their heat resistance.

Dependent: Check the temperature of the cups with a thermometer

(heat). Controlled: For the controlled variables we will use the same thermometer and wait 20 seconds to put the thermometer on the surface of the cup and leave the thermometer on for 30 seconds for each cup.

We're also put the same amount of water at the same temperature in all three cups.

Method:

Step 1: Put the 3 cups on your bench and record their initial temperature.

Step 2: Pour in enough water for your experiment Into the kettle and heat up your water.

Step 3: Pour 200 mL into the first cup and start the 20 seconds on the stopwatch.

Step 4: After the 20 seconds put the thermometer in the water for 3 minutes

Step 5: At 1 minute record the temperature of the water, Then again at 2 minutes and 3.

Step 6: Repeat steps 1-5 with the other coffee cups.

Step 7: Do these steps with each cup 3 times.

Results Of The Test:

Time (Minutes) (Styrofoam Cup)	Temperature Of Water Test 1 (°C)	Temperature Of Water Test 2 (°C)	Temperature Of Water Test 3 (°C)
Initial temperature	85°	70°	83°
1 Minute	75°	66°	76°
2 Minutes	73°	65°	74°
3 Minutes	71°	63°	72°

Time (Minutes) (Smooth Cup)	Temperature Of Water Test 1 (°C)	Temperature Of Water Test 2 (°C)	Temperature Of Water Test 3 (°C)
Initial Temperature	88°	83°	84°
1 Minute	77°	76°	82°
2 Minutes	74°	73°	78°
3 Minutes	70°	71°	76°

Figure 40(a): High level assessment student sample submission

Time (Minutes) (Rigid Cup)	Temperature Of Water Test 1 (°C)	Temperature Of Water Test 2 (°C)	Temperature Of Water Test 3 (°C)
Initial Temperature	80°	80°	81°
1 Minute	73°	75°	79°
2 Minutes	71°	73°	76°
3 Minutes	69°	71°	74°

Average Temperature Of The Cups And Recyclability

Styrofoam Cup:

Initial temperature: 79.33°

1 minute: 72.33°

2 minutes: 70.67°

3 minutes: 68.67°

Temperature Drop: 10.66°

Recyclability Of the Cup:

Styrofoam is a very unrecyclable material and can really affect the environment if goes into the sea or is left on the street. It cannot be recycled which makes it less viable as a coffee cup. Out of the three cups this one is the worst for the environment so i wouldn't recommend using them.

Smooth Cup:

Initial temperature: 85°

1 minute: 78.33°

2 minutes: 75.00°

3 minutes: 68.67°

Temperature Drop: 16.33°

Recyclability Of the Cup:

The smooth cup is mainly made of cardboard which makes it very environmentally friendly. The only bad part about the cup is the fact that it has a plastic lid which is very bad for the environment and if not put in a bin can negatively affect our sea life or other animal life.

Rigid Cup:

Initial temperature: 80.33°

1 minute: 75.67°

2 minutes: 73.33°

3 minutes: 71.33°

Temperature Drop: 9°

Recyclability Of the Cup:

This cup is very similar to the smooth cup as it is also made out of cardboard and has a plastic lid, but it's rigid outer layer is made out of cardboard instead of non recyclable material. Although the outer layer is made of cardboard it uses more materials which means it would cost more and is more rubbish.

Graph:

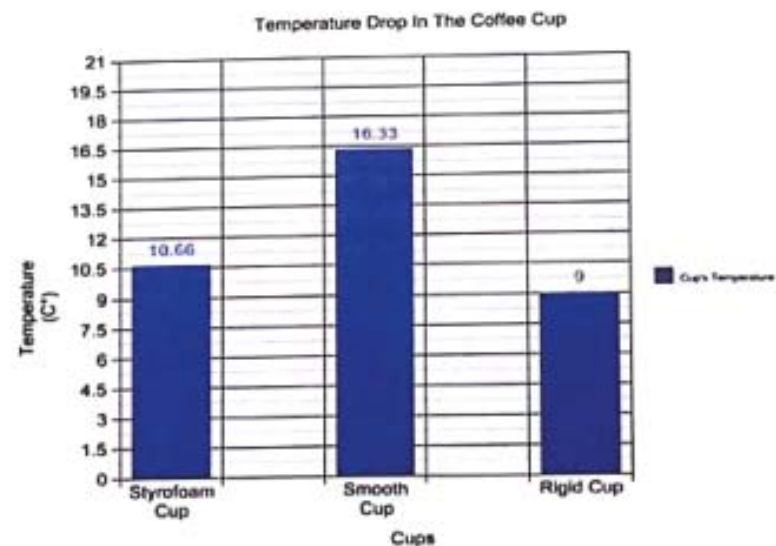


Figure 40(b): High level assessment student sample submission

Discussion And Evaluation:

I think that the tests were fairly good as we tested each cup three times took the averages and took the results from that. One thing that didn't go as well as hoped is that the smooth cups initial temperature was much higher than the other two. I believe that if we had an infrared thermometer it would have been more reliable in telling the temperature on the outside of the cups. Apart from those factors I think that my tests were reliable and did show me which cup was the most efficient.

Conclusion:

From the graph and the other results above it and the other results recorded it shows the differences of the cups using their recyclability and their heat resistance. From the research gathered I believe that the smooth cup is the best as it insulates the coffee the best without it going to cold so you won't burn your hands when holding it. It is also the best for recyclability as it uses the least amount of materials and the materials it does use are mostly recyclable. The second best cup is the rigid one as although it doesn't insulate the water as well as the styrofoam one it is much better for the environment as most of it's materials are recyclable. I have chosen the styrofoam one as the worst one, even though it is one of the best insulators it is not recyclable at all and if it went in the ocean it would be terrible for the sea life. Another reason for the styrofoam cup being the worst is that it is easily susceptible to being broken which could cause the coffee to leak.

Student Impact:

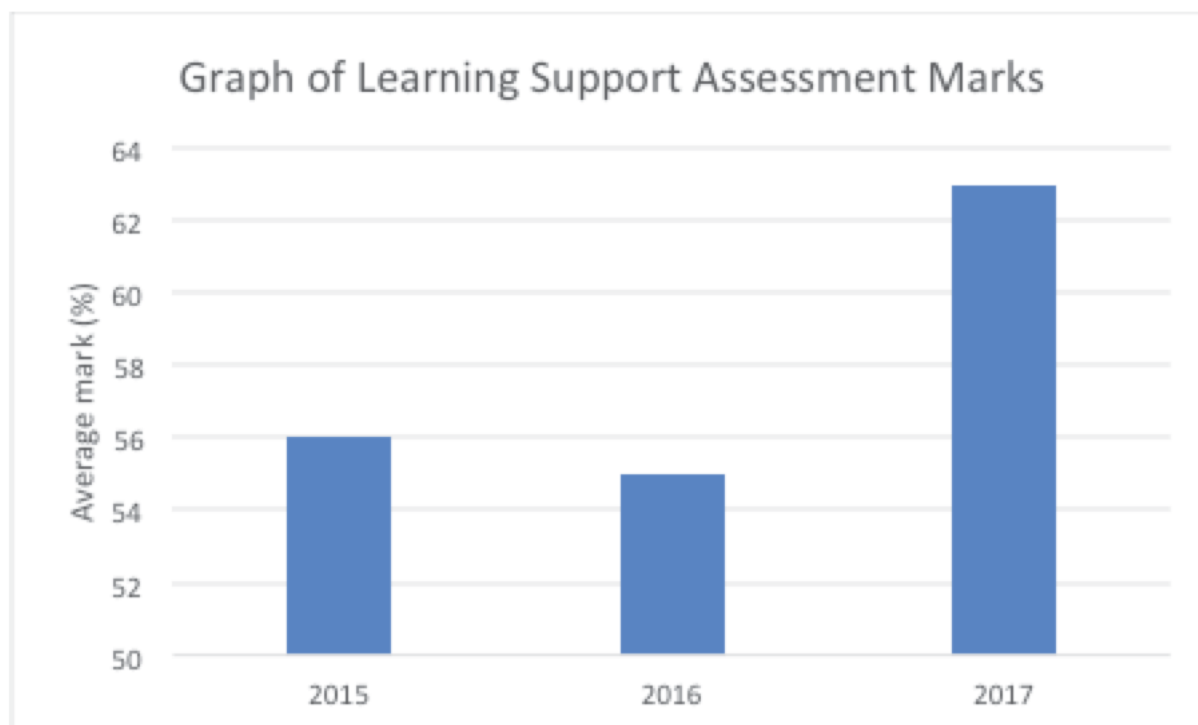
The pre-assessments, numeracy activities and creating activities based upon student data ultimately resulted in some very high sample submitted for the final report. The above report is an example which received 18/20 –an outstanding grade.

Figure 40(c): High level assessment student sample submission

General comments (including evidence of continually improving professional knowledge and practice, ability to respond constructively to the advice and feedback of colleagues and commitment to being actively engaged in the profession and wider community)

During the past 3 lessons teaching the in class coffee cup assessment, ●● has taken on all feedback (6.3.1.) to improve classroom management during practicals and now has a solid routine in place (4.3.1). He has consistently used formative feedback to inform his future lessons and has used a range of engaging pre-assessments and ICT resources (2.6.1.). Overall his scaffolding for learning support students and differentiation through ability grouping has helped the students immensely and their work quality has been much greater this year than in last years assessment.

Figure 41: Mentor Feedback



Student impact: Average mark of learning support students. The years 2015, 2016 did not have a scaffold for LS students. There was positive student impact of 8% learning improvement in 2017 compared to 2016 on the assessment task.

Figure 42: Overall impact on student learning.

This graph shows the increase in student achievement in learning support students in comparison to previous years (Data was extracted from Sentral database). Ultimately the student impact of this lesson sequence was positive and the strategies utilised within the teaching and learning cycles of the sequence were effective.