Coffee cup experiment

This evidence set was collected over two sequences of lessons in a Year 8 Science class during Professional Experience 2 (PE2). The Year 8 class consisted of 27 students of extremely diverse abilities and educational backgrounds. Five students were on learning support, one student had an Aboriginal background and three students were identified as highly gifted.

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 [redacted]				
Teacher Education Student [redacted]			School [redacted]	
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) Students understand the process of the scientific method and key concepts such as aim, hypothesis, method, variables, control and how to collect data.				
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	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.	Students enter class in an orderly manner and take their seats.	
	Write up the 5- minute classroom management strategy on the board.	Laptops closed and listening.	Verbal feedback
	On PowerPoint have learning goals for the lesson projected. Tell students about assessment task.	Students ask questions	
Body 15 minutes	Run Pre-assessment of student knowledge of scientific method. By using: 1) ABCD cards- pre-assessment multiple choice on scientific method concepts 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.	Students listening and can ask any questions or concerns	Formative pre-assessment to check for current understanding Verbal feedback
10 minutes	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.	Students can ask questions or concerns that they have	
20 minutes	Instruct students to complete report from aim up to a completed method section as we start the experiment tomorrow. Hand out differentiated scaffolds.	Learning support students working from differentiated scaffold.	Collect the student work samples and check over for student understanding.
	Collect the student coffee cups with names labelled. NOTE any groups without 3 cups in total.	Students hand in cups	
Conclusion 5 minutes	Recap scientific method steps we have covered. 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.	Students raise hands	Verbal feedback

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:

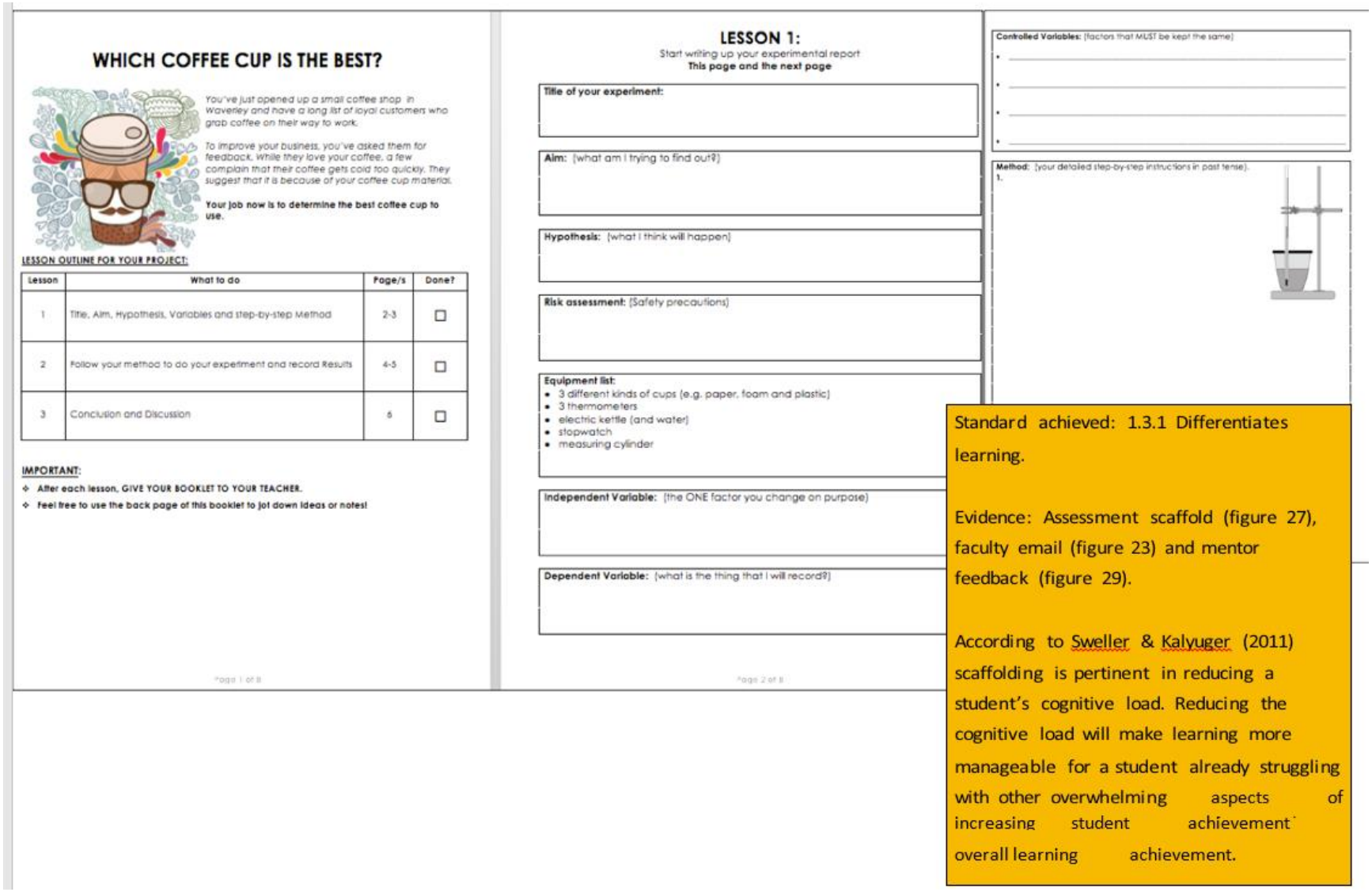
- Title
- Aim(s)
- Hypothesis
- Risk Assessment and safety precautions
- Experimental Variables
- Equipment List
- Method
- Results & Data – tables and graph should be included here
- Discussion and Evaluation
- Conclusion

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).

Figure 27: The scaffold for learning support students



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	☐
2	Follow your method to do your experiment and record Results	4-5	☐
3	Conclusion and Discussion	6	☐

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!**

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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?)

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

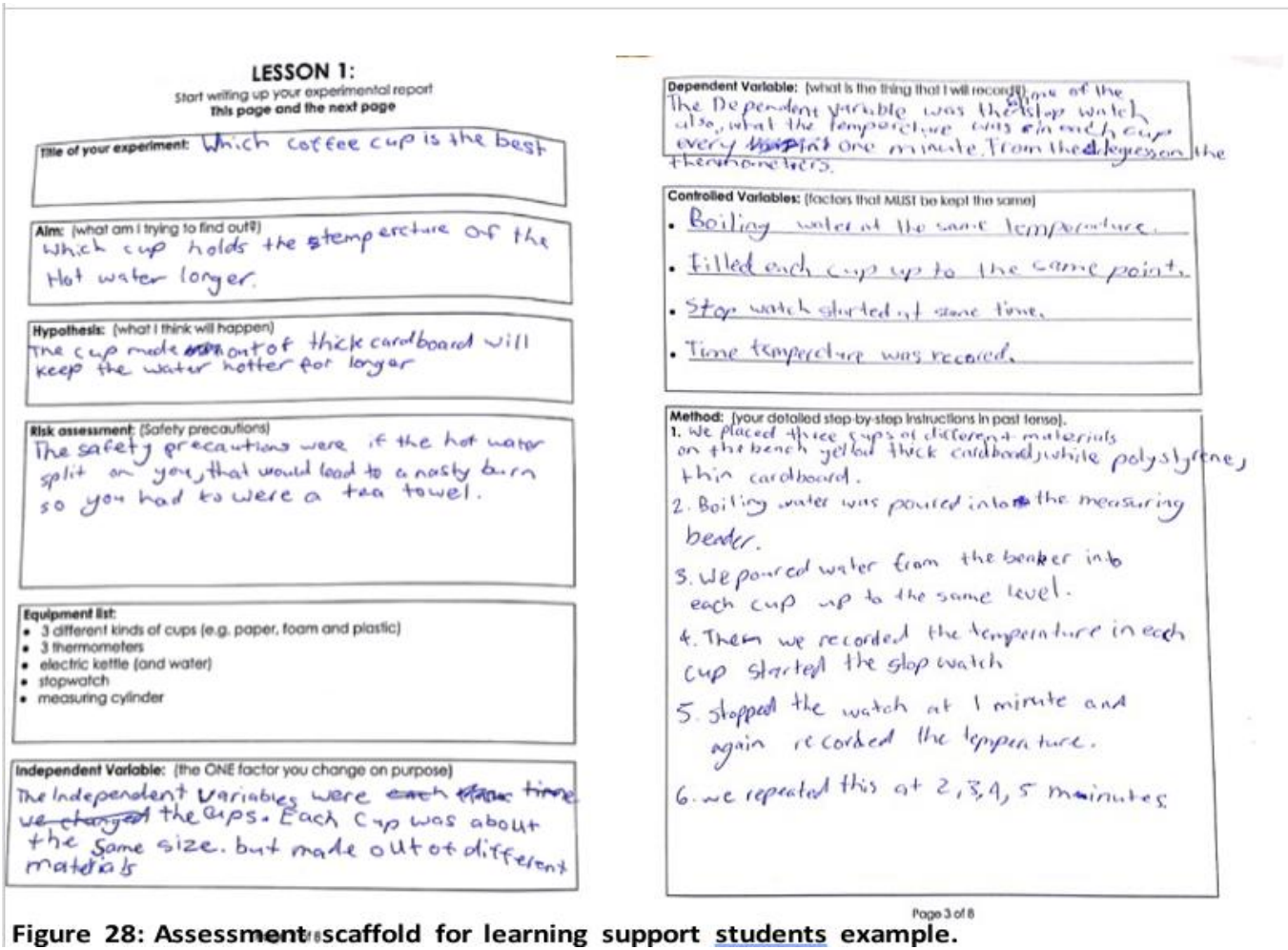
-
-
-
-

Method: (your detailed step-by-step instructions in past tense).
1.

Standard achieved: 1.3.1 Differentiates learning.

Evidence: Assessment scaffold (figure 27), faculty email (figure 23) and mentor feedback (figure 29).

According to Sweller & Kalyuger (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 increasing student achievement overall learning achievement.



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 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 were 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 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 one minute. From the digeson 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 recored.

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

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Figure 28: Assessment scaffold for learning support students example.

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.

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 Ben! Ben 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. Ben's 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. Ben 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

Reference

Sweller, J. (2011). CHAPTER TWO- Cognitive Load Theory. In P.M. Jose & H.R. Brian (Eds.), *Psychology of Learning and Motivation* (Vol. Volume 44, pp. 37-76): Academic Press.

Sweller, J., Ayres, P., & Kalyuga, S. (2011). *Cognitive load theory* (Explorations in the learning sciences, instructional systems and performance technologies). New York: Springer.