TARGETED INTERVENTIONS FOR PRAC-BASED LEARNING

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We will be discussing ideas for developing and implementing classroom activities that are targeted for different skill levels. Using skills based rubrics alongside results data enables the teacher to identify what students should be focusing on in order for them to progress to higher levels of achievement in relation to practical skills. Examples of how this has been done in AOS3 and other practical settings will be shared, and session participants will have the opportunity to apply new ideas to their own teaching practice.

SESSION OUTLINE

1) Collecting data
   - Science Faculty skills-based rubrics – progression from yr6-yr10 and VCE
   - Use rubrics with overlapping skill criteria in consecutive terms

2) Using the data to inform teaching –
   - Analyse skills achieved in Term 1 to identify areas to focus on in preparation for Term 2
   - Skills progression grouping of students
   - Develop skills progression activities

3) Evaluate impacts
   - Compare control data to data collected after formal interventions were used

4) Applying new ideas into your classroom

COLLECTING DATA

- Aitken Science Faculty has developed a ‘Practical investigation skills progression’ chart

Aitken College Practical Investigation Skills Progression

Practical Investigation Skills	Year 6	Year 7	Year 8	Year 9	Year 10
Questioning and predicting		Question Hypothesis	Question Hypothesis	Question Hypothesis	Question Hypothesis
Planning and conducting	Safety	Variables Procedure Safety	Variables Method Safety	Variables Method Safety	Variables Method Safety
Processing and analysing data and information	Observations Tables Graphs	Observations Tables Graphs	Observations Tables Graphs	Observations Tables Graphs	Observations Tables Graphs
Evaluating		Evaluates data Errors Links to theory Conclusion	Evaluates data Errors Links to theory Conclusion	Evaluates data Errors Modifications Links to theory Conclusions	Evaluates data Errors Modifications Links to theory Conclusions
Communicating			Scientific terminology	Scientific terminology	Scientific terminology

Key to the table of Science Practical Skills Progression

Orange – Introducing; can assess to a degree but we are not teaching to the top of the rubric

Green – Teaching; we teach it as fully as we can so that they can reach the top of the rubric

Purple – Consolidating; It has already been taught well and it will now be consolidated.

Last update: 8th June 2016

COLLECTING DATA

- Each skill has a number of levels which students progress through.
- Rubrics are created using the skills which are assessed for a given task

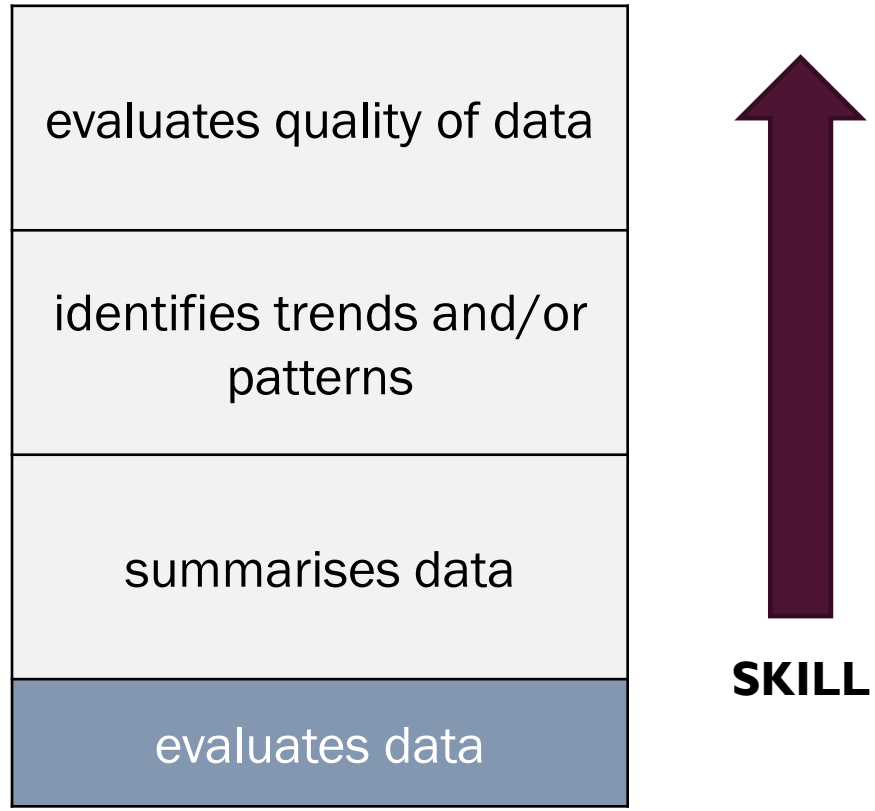
Practical Skills Rubric: *Unit 1 & 2 Chemistry*

				evaluates quality of data	uses theory to link or reconcile key findings including outliers			makes recommendations to overcome limitations
justifies predictions using known theory	uses a risk assessment that follows requirements		creates table that follows the set conventions	identifies trends and patterns	supports key findings using theories	assesses effect of errors on quality of data	predicts effect of modifications on quality of data	identifies limitations of key findings
structures prediction by distinguishing between variables	controls hazards	records observations relevant to method design	uses table to record data	summarises data	matches key findings with theory	distinguishes between types of errors	explains how modifications improve design	explains implications of key findings
makes predictions	identifies hazards	records observations	records data	includes data	identifies key finding	explains errors	suggests modifications	summarises key findings
makes predictions	**assesses risks**	**makes observations**	**records data**	**reports data**	**analyses results**	**evaluates method**	**modifies method**	**makes conclusions**
Planning		**Conduct experiment**	**Reporting results**		**Analysing and evaluating results**			
Correlation with Chemistry Study Design								
determine hypotheses and predictions that can be tested	*apply relevant occupational health and safety guidelines while undertaking practical investigations*	*systematically generate, collect, record and summarise both qualitative and quantitative data*	*systematically generate, collect, record and summarise both qualitative and quantitative data*		*determine to what extent evidence from an investigation supports the purpose of the investigation*	*evaluate investigative procedures*	*identification of limitations in data and methods, and suggested improvements*	*draw conclusions consistent with evidence and relevant to the question under investigation*
	follows recommended protocols from safety data		*organise, present and interpret data using schematic diagrams and flow charts, balanced chemical equations, tables, graphs, percentages and calculations*		*take a qualitative approach when identifying and analysing experimental data with reference to accuracy, precision, reliability, validity, uncertainty and errors (random and systematic)*			*discuss implications of research findings and proposals*
			take a qualitative approach when identifying and analysing experimental data with reference to accuracy, precision, reliability and validity		*links results to discuss relevant chemical information, ideas, concepts, theories and models and the connections between them*			*identify the limitations of conclusions*
					identification of outliers and their subsequent treatment			*make recommendations, as appropriate, for modifying or extending the investigation*

					uses theory to link key findings	predicts how errors affect quality of data	
supports predictions using theory				evaluates quality of data	uses theory to explain key findings	explains errors in method	explains limitations of conclusions
structures prediction using variables	makes observations relevant to method design	records observations relevant to method design	uses a table that follows the set standards	identifies trends and/or patterns	identifies key findings	identifies errors in method	supports key findings using theory
makes predictions	makes observations	records observations	records relevant data	summarises data	includes findings	includes errors	summarises key findings
makes predictions	makes observations	records data	represents data	evaluates data	analyses data	evaluates method	makes conclusions

COLLECTING DATA

- The same skills were assessed in Term 1 & 2
- This allowed skill progression to be monitored



COLLECTING DATA – DISCUSS WITH YOUR COLLEAGUES

- What types of data do you collect from your students?
- How have you and/or your science faculty collected different types of data?

USING DATA – TERM 1 RUBRIC RESULTS

Guttmanchart

Sort Data

Unsort Data

Student	1.1 make	1.2 struct	1.3 suppo	2.1 make	2.2 make	3.1 recor	3.2 recor	4.1 recor	4.2 uses	5.1 sumr	5.2 ident	5.3 evalu
Student 1	1	1	0	1	0	1	0	1	1	1	0	0
Student 2	1	0	0	1	0	1	1	1	1	1	1	0
Student 3	1	0	0	1	1	1	0	1	1	1	1	0
Student 4	1	0	0	1	0	1	0	1	0	1	0	0
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Student 6	1	0	0	1	0	1	0	1	1	0	0	0
Student 7	1	1	0	1	1	1	1	1	1	1	1	0
Student 8	1	0	0	0	0	1	0	1	1	1	0	0
Student 9	1	1	0	1	0	1	0	1	0	1	1	0
Student 10	1	0	0	1	0	1	1	1	1	0	0	0
Student 11	1	1	0	1	0	1	0	1	1	1	0	0
Student 12	1	0	0	1	0	1	1	1	1	1	0	0
Student 13	1	1	0	1	1	1	1	1	1	1	1	0
Student 14	1	1	0	1	1	1	1	1	1	1	1	0
Student 15	1	0	0	1	0	1	0	1	1	1	1	0
Student 16	1	0	0	1	0	1	0	1	1	0	0	0
Student 17	1	0	0	1	0	1	0	1	1	1	1	0
Student 18	1	0	0	1	0	1	0	1	1	1	0	0
Student 19	1	0	0	1	1	1	1	1	1	1	0	0
Student 20	1	0	0	1	0	1	0	1	1	1	1	0
Student 21	1	0	0	1	1	1	0	1	1	1	0	0
Student 22	1	1	0	1	1	1	1	1	1	1	1	0
Student 23	1	1	0	1	1	1	1	1	1	1	1	0

USING DATA – TERM 1 RUBRIC RESULTS

Student	1.1 make	3.1 recor	4.1 recor	2.1 make	7.1 inclu	4.2 uses	5.1 sumr	6.1 inclu	7.2 ident	8.1 sumr	5.2 ident	6.2 ident	3.2 recor	1.2 struct	2.2 make	7.3 expla	7.4 predi	8.2 supp	6.3 uses	1.3 supp
Student 23	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
Student 7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
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Student 22	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	0
Student 13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Student 5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Student 2	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0	0	0	0	1	0
Student 9	1	1	1	1	1	0	1	1	1	1	1	1	0	1	0	1	0	0	0	0
Student 19	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	0	0	0	0	0
Student 1	1	1	1	1	1	1	1	0	1	1	0	0	0	1	0	1	0	0	0	0
Student 3	1	1	1	1	1	1	1	1	0	1	1	0	0	0	1	0	0	0	0	0
Student 12	1	1	1	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0	0	0
Student 18	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	0	0	0	0
Student 21	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	1	0	0	0	0
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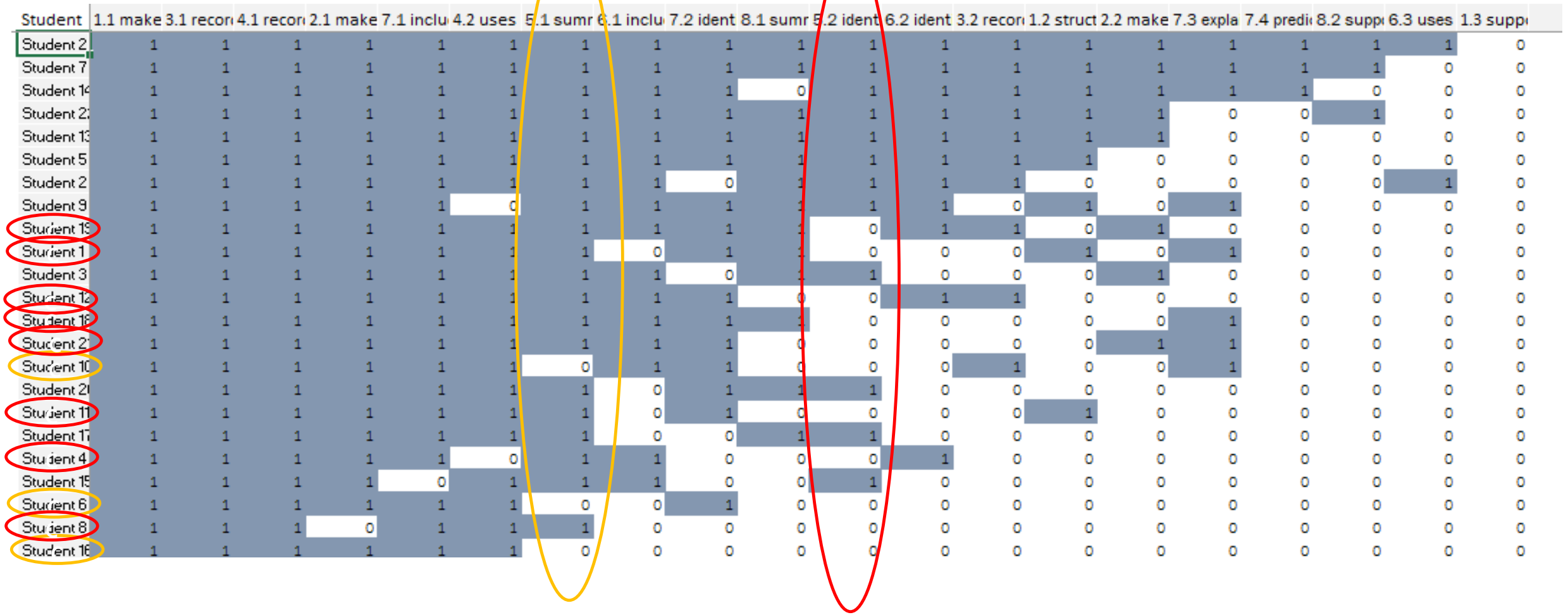
Student 20	1	1	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0
Student 11	1	1	1	1	1	1	1	0	1	0	0	0	0	1	0	0	0	0	0	0
Student 17	1	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0
Student 4	1	1	1	1	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0
Student 15	1	1	1	1	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Student 6	1	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Student 8	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Student 16	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

					uses theory to link key findings	predicts how errors affect quality of data	
supports predictions using theory				evaluates quality of data	uses theory to explain key findings	explains errors in method	explains limitations of conclusions
structures prediction using variables	makes observations relevant to method design	records observations relevant to method design	uses a table that follows the set standards	identifies trends and/or patterns	identifies key findings	identifies errors in method	supports key findings using theory
makes predictions	makes observations	records observations	records relevant data	summarises data	includes findings	includes errors	summarises key findings
makes predictions	makes observations	records data	represents data	evaluates data	analyses data	evaluates method	makes conclusions

USING DATA – IDENTIFY SPECIFIC TARGET GROUPS



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Student 2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
Student 7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Student 14	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0
Student 22	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	0
Student 13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
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Student 18	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	0	0	0	0
Student 21	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	1	0	0	0	0
Student 10	1	1	1	1	1	1	0	1	1	0	0	0	1	0	0	1	0	0	0	0
Student 20	1	1	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0
Student 11	1	1	1	1	1	1	1	0	1	0	0	0	0	1	0	0	0	0	0	0
Student 17	1	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0
Student 4	1	1	1	1	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0
Student 15	1	1	1	1	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Student 6	1	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Student 8	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
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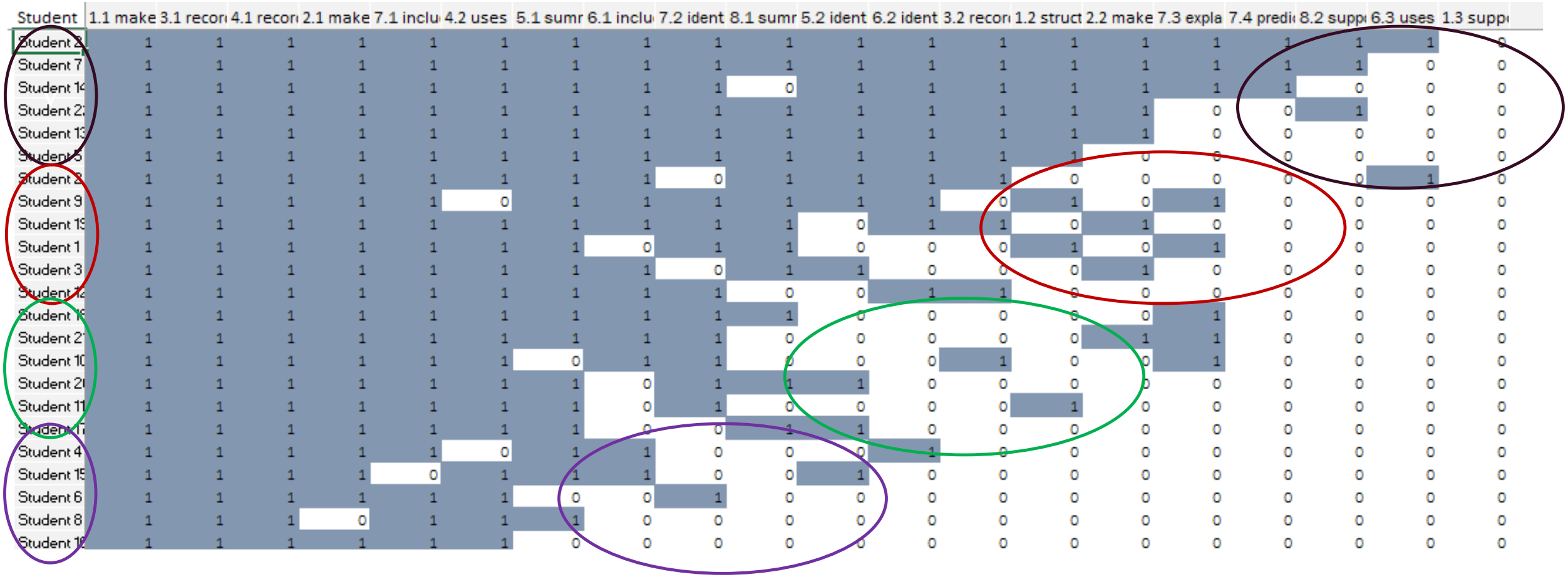
USING DATA – IDENTIFY GENERAL TARGET GROUPS



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Student 2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
Student 7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Student 14	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0
Student 22	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	0
Student 13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
Student 5	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	0
Student 2	1	1	1	1	1	1	1	1	0	1	1	1	1	0	0	0	0	0	1	0
Student 9	1	1	1	1	1	0	1	1	1	1	1	1	0	1	0	1	0	0	0	0
Student 19	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	0	0	0	0	0
Student 1	1	1	1	1	1	1	1	0	1	1	0	0	0	1	0	1	0	0	0	0
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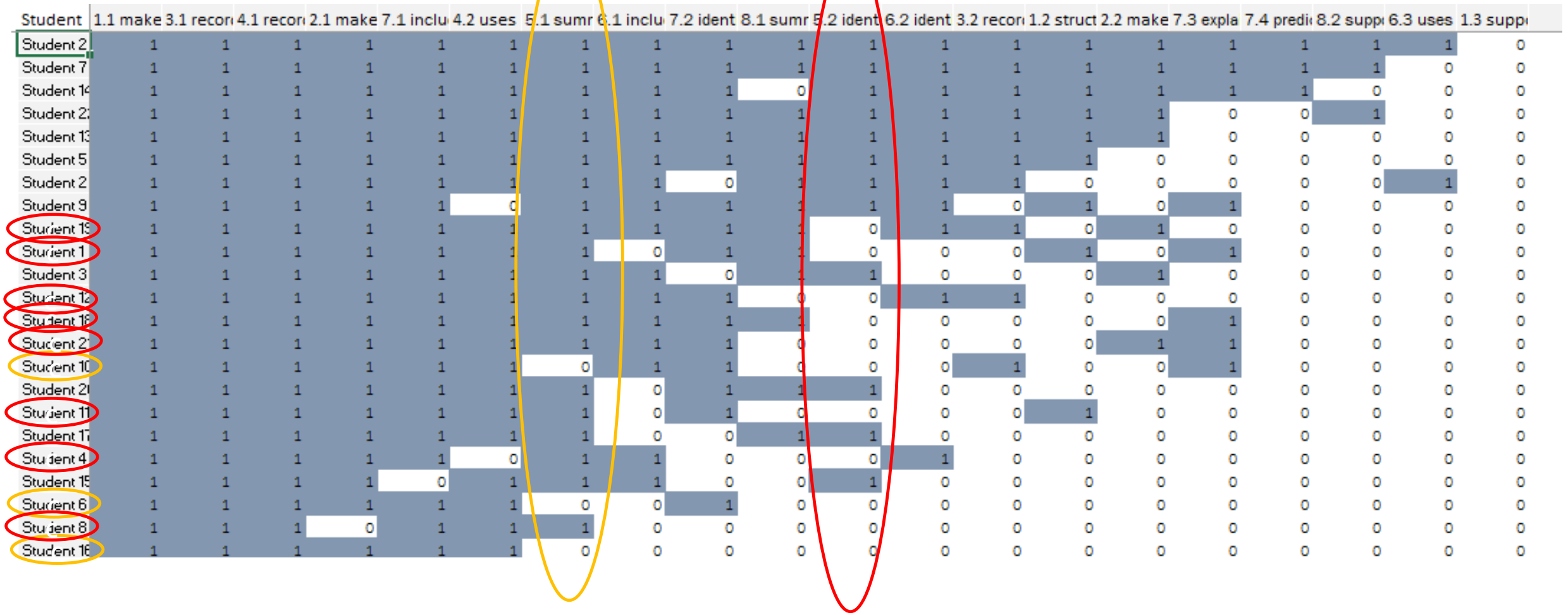
Student 12	1	1	1	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0	0	0
Student 16	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	0	0	0	0
Student 21	1	1	1	1	1	1	1	1	1	0	0	0	0	0	1	1	0	0	0	0
Student 10	1	1	1	1	1	1	0	1	1	0	0	0	1	0	0	1	0	0	0	0
Student 20	1	1	1	1	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0
Student 11	1	1	1	1	1	1	1	0	1	0	0	0	0	1	0	0	0	0	0	0
Student 17	1	1	1	1	1	1	1	0	0	1	1	0	0	0	0	0	0	0	0	0
Student 4	1	1	1	1	1	0	1	1	0	0	0	1	0	0	0	0	0	0	0	0
Student 15	1	1	1	1	0	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0
Student 6	1	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
Student 8	1	1	1	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
Student 18	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

USING DATA – IDENTIFY SPECIFIC TARGET GROUPS



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Student 2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0
Student 7	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0
Student 14	1	1	1	1	1	1	1	1	1	0	1	1	1	1	1	1	1	0	0	0
Student 22	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	0
Student 13	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	0	0	0	0	0
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Student 9	1	1	1	1	1	0	1	1	1	1	1	1	0	1	0	1	0	0	0	0
Student 19	1	1	1	1	1	1	1	1	1	1	0	1	1	0	1	0	0	0	0	0
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Student 6	1	1	1	1	1	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
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Student 16	1	1	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0

USING DATA – IDENTIFY SPECIFIC TARGET GROUPS

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Student 2	1	0	0		1	0		1	1		1	1			1	1	0
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Student 9	1	1	0		1	0		1	0		1	0			1	1	0
Student 10	1	0	0		1	0		1	1		1	1			0	0	0
Student 11	1	1	0		1	0		1	0		1	1			1	0	0
Student 12	1	0	0		1	0		1	1		1	1			1	0	0
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Student 14	1	1	0		1	1		1	1		1	1			1	1	0
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Student 16	1	0	0		1	0		1	0		1	1			0	0	0
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Student 18	1	0	0		1	0		1	0		1	1			1	0	0
Student 19	1	0	0		1	1		1	1		1	1			1	0	0
Student 20	1	0	0		1	0		1	0		1	1			1	1	0
Student 21	1	0	0		1	1		1	0		1	1			1	0	0
Student 22	1	1	0		1	1		1	1		1	1			1	1	0
Student 23	1	1	0		1	1		1	1		1	1			1	1	0

USING DATA - ASSIGNING TARGET GROUPS

evaluates quality of data
identifies trends and/or patterns
summarises data
evaluates data

SKILL

Skill Focus: Evaluating data

Skill Level focus (ZPD)
XXX: summarise data
XXX XXX XXX: identify patterns and trends
XXX XXX XXX XX: evaluates the quality of data

Teacher's Bench
Ms. Herron

23 David 8Lachlan	19Claudia 14Anton	17Mikayla 20Jiyan
3Kristyn 7Hamish	6Amy 21Nikolas	9Olivia 4Noah
18Shanya 2Joshua	22Matisse 5Joseph	1Kiralee 11Krstan
12Ronan 16Alijah	10Jack	13Taner 15Taya

USING DATA – CREATING SKILL PROGRESSION ACTIVITIES

Effect of Soil Temperature on the Germination Rate of Pumpkin Seeds

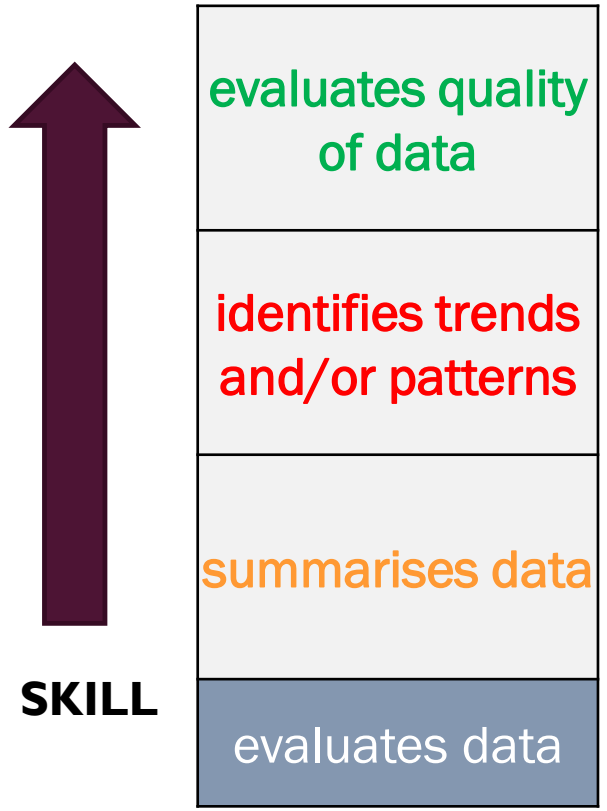
Soil Temperature (°C)	Germination Rate (%)			Average Germination Rate (%)
	X	X	X	
20	60	64	70	65
24	75	78	82	78
28	86	84	83	84
32	69	65	63	66

1) Fill in the blanks to complete the trends:

The lowest temperature tested (20°C) and the _____ temperature tested (32°C) yielded similar results with an average germination rate of 65% and 66% respectively. The highest average germination rate of 84% was recorded at _____°C, while the germination rate for the 24°C trial was half way in between the 20°C and 28°C rates.

From 20°C to ____°C, the average germination rate _____, however, at 32°C the germination rate shows a significant decline. This pattern of results reveals a trend indicating that as temperature increases up to _____°C, germination also increases, but _____ at 32°C.

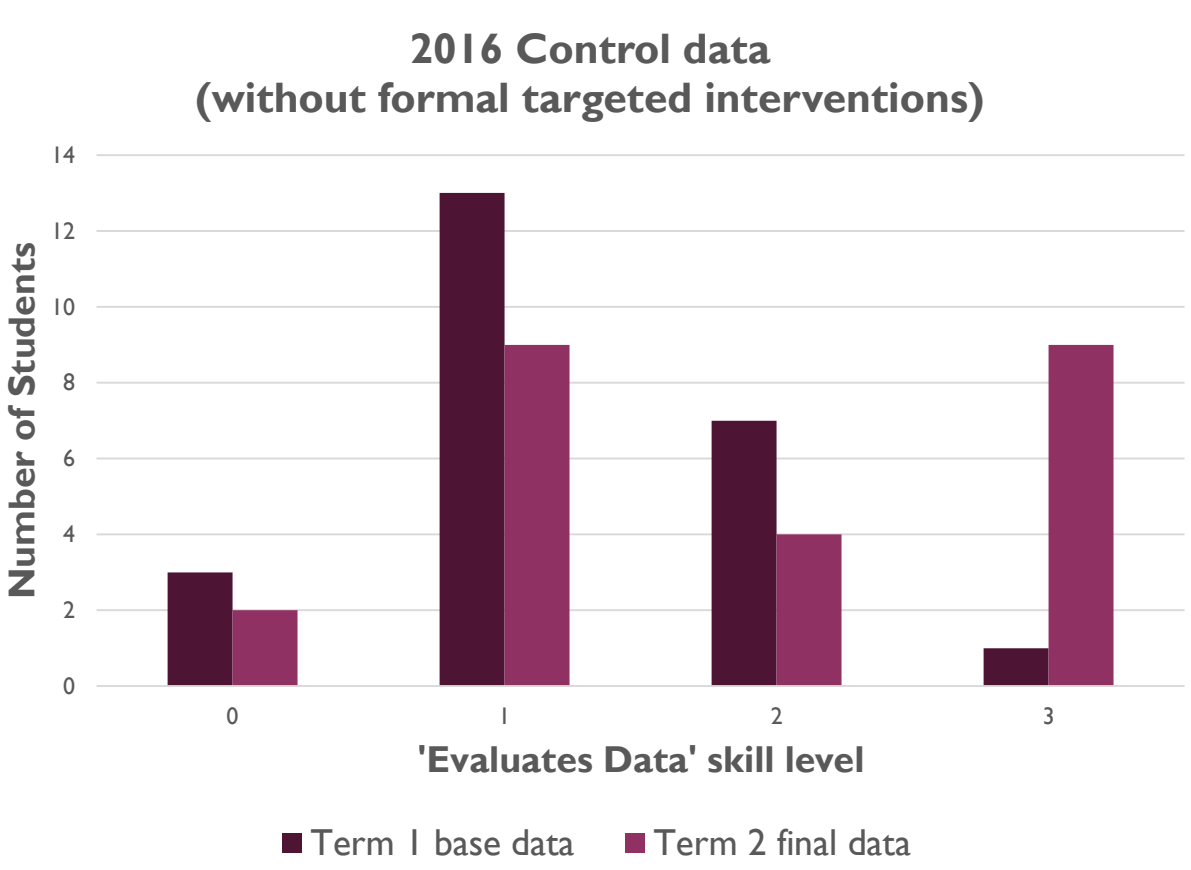
Because it was difficult to control all external variables, the quality of the data was _____ impacted. The _____ of the pumpkin seeds varied as did their relative health. Some seeds were large and plump, while others were desiccated. These variations were not consistent throughout the experimental trials which limits the quality of the results. Uncontrolled factors would have affected the average germination rates, making it difficult to determine if our independent variable alone was responsible for the germination rates.

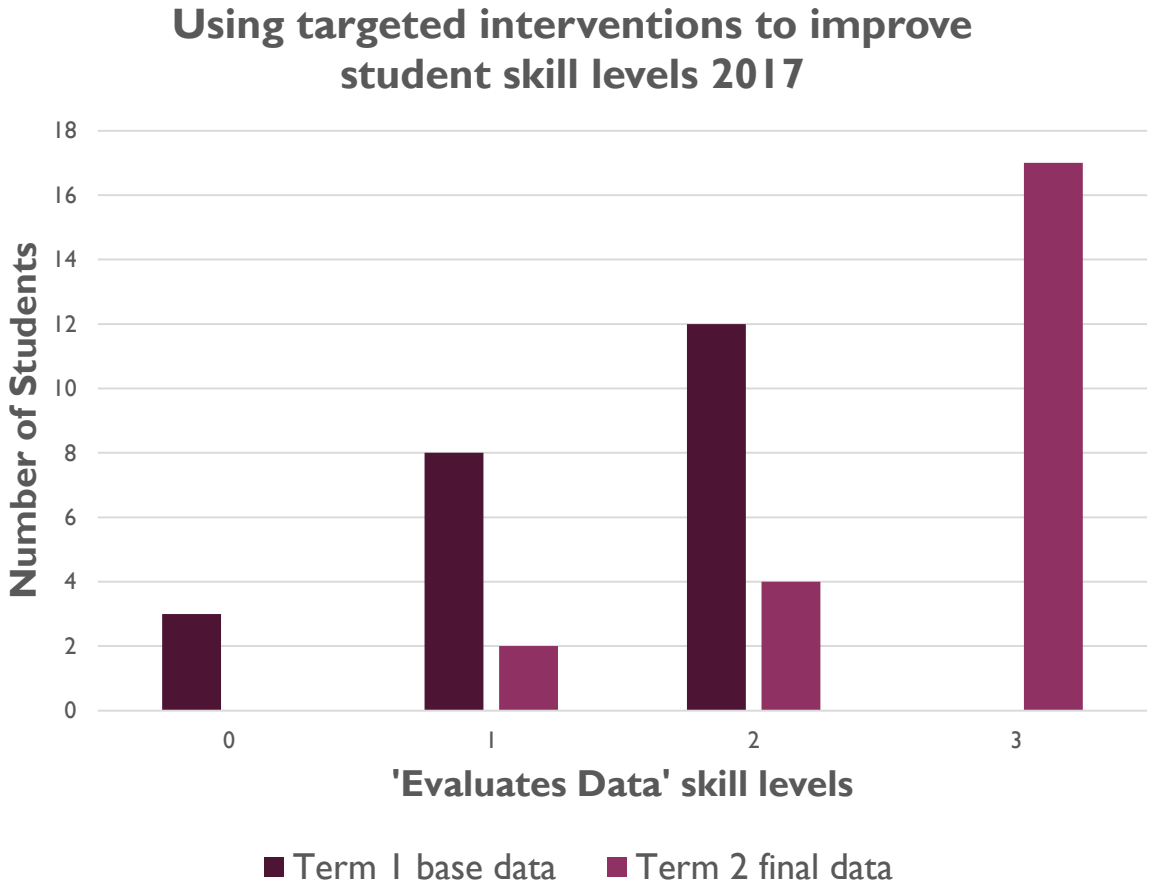


USING DATA – DISCUSS WITH YOUR COLLEAGUES

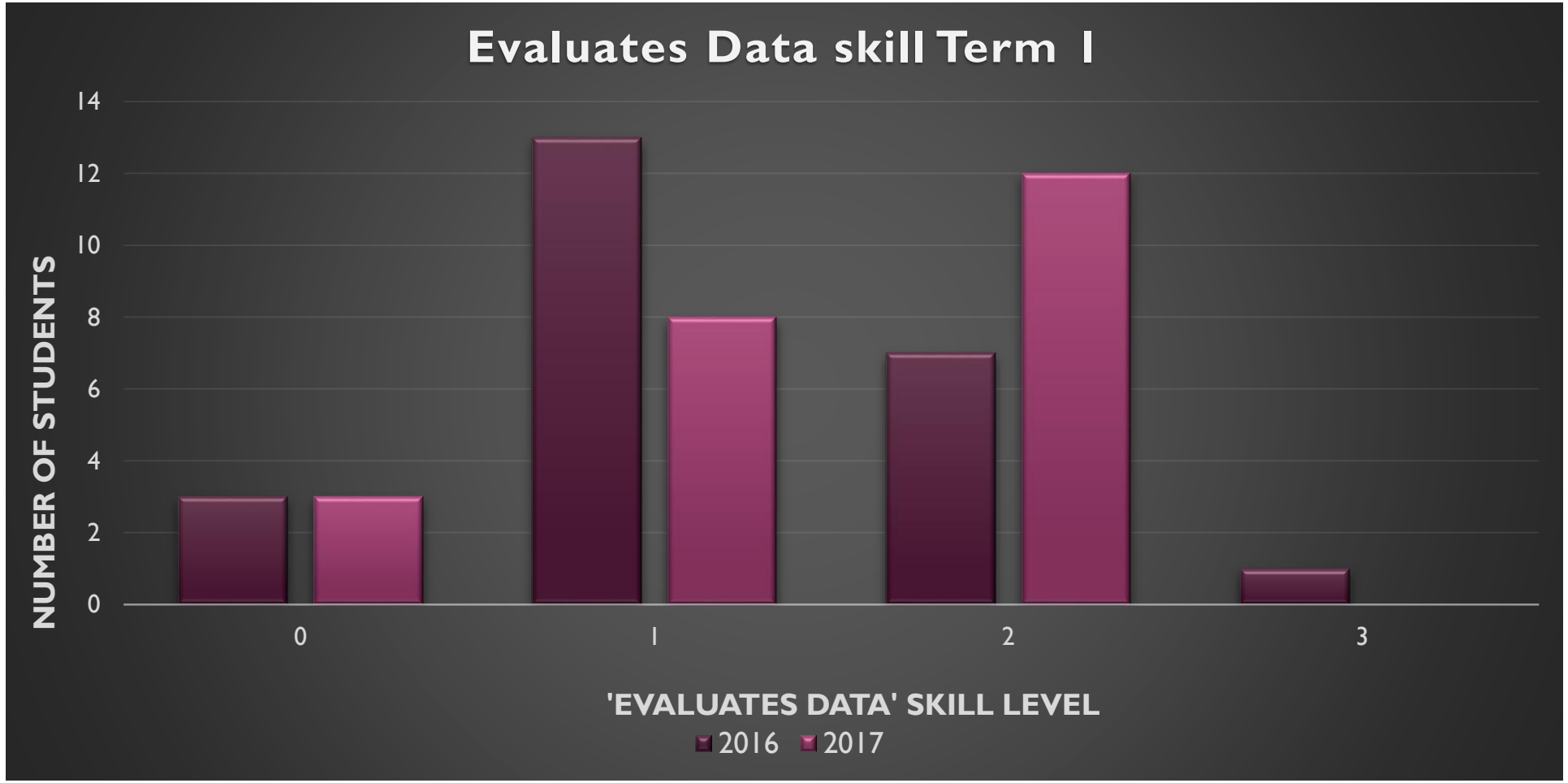
- How are you already using data in the classroom?
- How have you used data specifically to inform your teaching?

IMPACT EVALUATION – COMPARING DATA

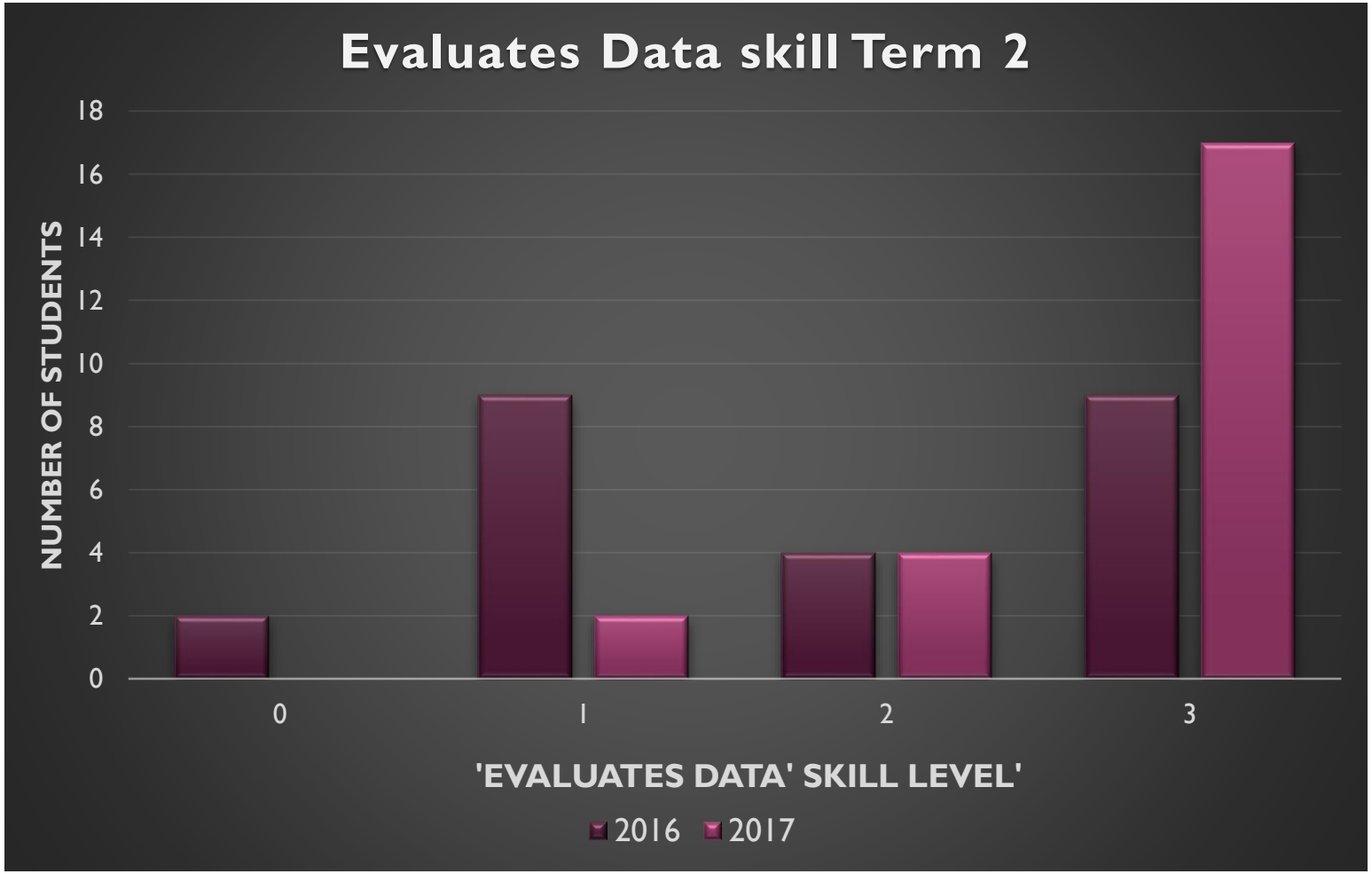




IMPACT EVALUATION – COMPARING DATA



IMPACT EVALUATION – COMPARING DATA



OTHER WAYS TO TARGET SKILL LEVELS

Discussion Planning Document (print to A3)

1. Aim

2. Summarises data

Identifies trend or pattern in data

3. Key finding (related to aim)

Theory to explain key finding

4. Link key findings and/or unusual results

5. Error (this is not a mistake that can be fixed by repeating the experiment)

7. Modifications (these should at

6. Error (this is not a mistake that can be fixed by repeating the experiment)

8. Conclusion — summarises the

evaluates quality of data	uses theory to link or reconcile key findings including outliers			makes recommendations to overcome limitations
identifies trends and patterns	supports key findings using theories	assesses effect of errors on quality of data	predicts effect of modifications on quality of data	identifies limitations of key findings
summarises data	matches key findings with theory	distinguishes between types of errors	explains how modifications improve design	explains implications of key findings
includes data	identifies key finding	explains errors	suggests modifications	summarises key findings
reports data	**analyses results**	**evaluates method**	**modifies method**	**makes conclusions**

OTHER WAYS TO TARGET SKILL LEVELS

Discussion of Results

This section includes an analysis of your data, stating and explaining the key findings and evaluating the method. The checklist below can be used as a guide.

Discussion Checklist

	Includes a summary of the results in one or two sentences. Actual data values are included
	Trends and/or patterns in the data are identified, normally leading to the key finding of the experiment
	Key findings are supported (or refuted) using the background the
	Identify and explain strong errors in the method. These are not r
	Suggests and explains modifications that will improve the metho

Conclusion

The conclusion briefly summarises and explains the key findings and st
achieved. It is important that no new information is included in the co

Conclusion Checklist

	Briefly summarises and explains the main findings
	States the implications of the findings
	Identifies limitations of the conclusion (not errors in meth
	Suggests ways to overcome limitations

evaluates quality of data	uses theory to link or reconcile key findings including outliers			makes recommendations to overcome limitations
identifies trends and patterns	supports key findings using theories	assesses effect of errors on quality of data	predicts effect of modifications on quality of data	identifies limitations of key findings
summarises data	matches key findings with theory	distinguishes between types of errors	explains how modifications improve design	explains implications of key findings
includes data	identifies key finding	explains errors	suggests modifications	summarises key findings
reports data	**analyses results**	**evaluates method**	**modifies method**	**makes conclusions**

OTHER WAYS TO TARGET SKILL LEVELS

Title: Growing metallic crystals

Hypothesis

A hypothesis is an **educated** prediction based on scientific ideas of what you think will happen. A good hypothesis will include a scientific reason to justify the reasoning and is usually written as an "If _____ then _____ because _____" statement. It should include the independent and dependent variables, as well as the predicted affect, supported by background theory.

Hypothesis Checklist

	Uses an 'If___ then_____ because _____' statement
	Includes the **independent variable**
	Includes the **dependent variable** and the **predicted effect**
	Provides **theoretical justification**

If *silver* is a standard metal, **then** when its crystals are formed slowly, *regular repeating patterns* in its *structure* will be observed. This is **because** the metallic bonding model states that the structure of metallic substances is based on the *3-D lattice arrangement of fixed cations held in place by a sea of de-localised electrons*.

justifies predictions using known theory

structures prediction by distinguishing between variables

makes predictions

makes predictions

APPLYING THESE IDEAS INTO YOUR CLASSROOM

- How do/will you collect data?
- How do/will you interpret the data?
- How do/will you target specific skills or ability groups?
- How do/will you measure the impact?

QUESTIONS FROM PARTICIPANTS?

TARGETED INTERVENTIONS FOR PRAC-BASED LEARNING

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www.edudesign.com.au

Thank you for attending this session. I hope your found it useful.

Please use my email address above if you wish to provide feedback of any kind, or would like to share resources related to using data to inform teaching.