Appendix A: Teacher survey

Teacher Survey for Te Reo Tātaitai

Name: _____

1a) How has your attitude to **mathematical language** changed?

Lots some little none any other response

b) Has your knowledge about **mathematical language** changed as a result of being involved in this project?

Lots some little none any other response

c) Explain why you think this has been the case.

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2 a) How has your attitude to **mathematics** changed?

Lots some little none any other response

b) Has your knowledge of **mathematics** changed as result of being involved in this project?

Lots some little none any other response

c) Explain why you think this has been the case.

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3 a) How has your attitude to **mathematics teaching** changed?

Lots some little none any other response

b) Has your knowledge of **mathematics teaching** changed as a result of being involved in this project?

Lots some little none any other response

c) Explain why you think this has been the case.

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4) Do you think that the students' mathematics understanding has improved as a result of you participating in the project? Yes/No

Why do you think that? How do you know that?

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5) When we looked at the video of your teaching, we talked about the strategies that you were using to teach mathematical language. To do this we talked about the 4 stages of learning the mathematics register (Noticing, Intake, Integration and Output).

a) In the Noticing stage, there were strategies like 'repeating new terms and expressions several times in appropriate places' and 'rephrasing the expressions by using other terms'. How did knowing more about these strategies affect your own teaching?

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b) In the Intake stage, there were strategies like ‘repeating the students’ appropriate responses’ and ‘having students work backwards from an inappropriate answer to the question which was asked’. How did knowing more about these strategies, affect your own teaching?

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c) In the Integration stage, there were strategies like ‘facilitate an environment where students will correct each other’ and ‘reminding students to think about what they already know’. How did knowing more about these strategies affect your own teaching?

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d) In the Output stage, there were strategies like ‘providing opportunities for students to use their language’ and ‘providing an environment in which the students can query the language use of the teacher’. How did knowing more about these strategies affect your own teaching?

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e) Did you find talking about the 4 stages helpful when thinking about your teaching of mathematical language? Why was that?

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6) What do we need to learn from doing this project for when we start investigating mathematical writing?

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7) Is there anything else you would like to add?

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Appendix B: T1's scaffolding strategies

Times – Lesson 1, American – Lesson 2, Arial Lesson 3, *Italics – Lesson 4*, **Bold – Lesson 5**

T1	Teacher Initiated	Student Initiated	Comments
Noticing	• use of 'ara' to mark that a definition will follow • use of kē to mark that information following may be unexpected • after going over a new rule, the teacher begins a sentence for students to complete with a one word answer • 'he momo koeko' is rephrased as 'te whanau koeko' • teacher begins by asking how many dots can be seen. She then clarifies through a series of leading questions what is meant by 'seen' in this context teacher asks a series of leading questions which have clear, one-idea answers that build towards the equation (te whāritenga) which is what the teacher originally expected the students to provide • teacher reminds students of the relationship between pout• and te pou pout• (vertical and a pole) teacher uses the term and describes it more fully • teacher asks whether the number of dots is different for several configurations of the blocks teacher then says '22 ke te mea rahi rawa i t•n•i wa' (the most dots you can have is 22) • *teacher rephrases 'he rerekē te nuka' as 'tirohangā'* • *teacher rephrases 'te whakautu' as 'te otinga kimi' and repeats 'te whakautu'*	• students make (wild) guesses about the number of dots that can be seen • student offers 'ele' (L-shaped) as the name of a configuration of blocks. students keep saying that the number of dots is the same	Language devices in Māori to highlight/alert the need to listen. This fill-in-the-blank sentence has only one possible response. Teacher accepts the term offered but then describes it more fully so that there is a shared definition of the term's meaning. This exercise reinforces what '•rite' (same) means in this situation. This then leads to the modelling of the sentence about the most dots that you can have.

	• *teacher rephrases 'nuka tere' as 'huarahi tere'* • *teacher uses 'i te mea' in several explanations*		By repeating the expression, the teacher would be modelling its use in explanations

T1	Teacher Initiated	Student Initiated	Comments
Intake	• teacher asks for different 3-D shapes (which can be related to Euler's rule)	student offers pororua (cylinder)	This exchange starts with a more general request than those seen in the Noticing stage. However, when a student suggests a 3-D shape to which Euler's rule cannot be applied, the teacher limits the students' choices.
	teacher then restricts students' choices to the family of pyramids	students offer different suggestions of types of pyramids (porotapatoru)	
	• teacher asks how many faces and vertices there are on a 'koeko tapatoru'	student responds with 10	Students are once again given more option to show their understanding of the terms. The teacher's counting reinforces that they were correct
	teacher then asks for the number of sides		
	teacher counts the sides and asks again for the number of sides before asking them to add on an extra 2, following Euler's rule	student responds with 8	
	• teacher begins an explanation of how to work out the number of dots, which students need to complete with one word answers		Could be noticing, except 'tango' has not been used by the teacher previously. Students are channelled into using this term that they already know in this new context.
	• teacher asks for the names of different shape configurations (huapae - horizontal, pout•, ele - l-shaped)		
	teacher goes over the need for the blocks to be face-to-face (mata ki te mata)	• one group of students has a configuration where the blocks are separate.	
	• teacher asks a student to explain fully how she got the number of dots in her block configuration	Student gives a short answer	
	teacher adds extra words that the student repeats		This part of the exchange is probably more like the Integration Stage but with the reversion to Intake when it is clear that the student's answer does not fulfil the teacher's
	teacher has the student repeat what she said so that other students who were talking could hear the explanation. Teacher then has the student count the missing dots to show that the amount is not less than 22 which is what the problem was	Student then provides other details	

			requirement of a building which shows fewer than 22 dots.
	teacher prompts to get an explanation of how the number was achieved (even offering a calculator for the student to use to work it out) teacher starts to repeat a student response when the needed answer was given Teacher rephrases the student's response as a generalisation (without all of the specific amounts)	• student responds to question about the number of dots students respond with numbers (sometimes inappropriate numbers) students complete the repeated sentence • student gives an explanation using specific numbers • **Student uses term 'huapae'** **Another student then uses a mispronounced version, 'ruapae'**	In this exchange, the teacher is not suggesting that the student's response is wrong, just that there is another (more appropriate) way of expressing the explanation

T1	Teacher Initiated	Student Initiated	Comments
Integrat -ion	• ‘āta whakaaro kao’ (command to understand)		Students are credited with being able to understand but the teacher is aware that some might miss the opportunity to do so
	Teacher asks for repetition by repeating the initial past tense participle (‘e’)	• student provides explanation student completes repetition	Students are again expected to understand others’ contributions but the teacher’s intervention highlights the need for students to understand
	• teacher makes a formal requestion for a student to repeat what they said	• student requests clarification of task requirements ‘ngā mea o raro?’	
	• teacher asks the students to explain their strategies for working out how many dots there are.	students provide strategies using/giving specific amounts in their explanations and the use of ‘i ngā mea’.	
	• teacher commands the students to provide full descriptions of how to work out how many dots (not just saying horizontal or vertical) are in the configurations of blocks. She then provides an example. Teacher moves the students from counting to using a more general equation/strategy using subtraction to work out how many dots can be seen. Students are prompted to use what they already know. teacher focuses students back on to the original question (ko te p•tai tonu – the question was). this discussion of the most dots is then turned around to ask students to think about a block configuration with the least number of dots showing.	Student then gives an explanation which is not terribly clear. • students go off track in responding to the teacher’s questions.	This exchange has parts where the teacher is encouraging students to use the language they already have (to recognise that they can give an equation rather than just use a counting strategy) but is restrictive at times, such as would be more typically seen at the Intake Stage.

	teacher asks about the number of dots which can't be seen teacher queries this suggestion teacher then commands the student to think before speaking again • Teacher asks students to make isometric drawings of their block configurations and to explain their strategies for determining the number of blocks (writing equations is given as a suggestion for doing this). teacher prompts for more details • *teacher uses 'nē' and 'neha' as requests for interaction* • *teacher reminds students of what was covered in the previous lesson (e hia ngā ira and location words)*	• student describes the arrangement of blocks student suggests that they should be added student gives a fuller explanation of adding 4 • Student gives an explanation of how he got 24 blocks for his drawing student provides details when prompted so that he gives a fuller explanation	The student is fairly competent but needs prompting similar to that in the Intake stage to provide a full explanation.

T1	Teacher Initiated	Student Initiated	Comments
Output	• teacher commands students to draw the different configurations of blocks	• student explained a problem with the numbers given in a table for Euler's rule • student queries whether the number of dots that have to be seen is 22 • **students use location words in giving an explanation describing the amounts in blocks and in describing the arrangements of different coloured blocks**	The student raised this problem with the teacher at the end of a previous lesson. The teacher introduced this in a new lesson and asked the child to state what the problem was.

Appendix C: T1's commentary of 2006 lessons

Class: Tau 7/8
Teacher: T1 Lesson: 1

Overall Objective: Using the appropriate mathematical equipment for constructing angles, and using this knowledge to create triangles.
Curriculum Strand: NZMC Level 4 Geometry.
Topic: Triangles.

Resources for this first activity:
Paper
Pencil/ruler
Demonstration on blackboard.

I wanted to recap a little on some things we as a class had done a term ago. The different types of angles; acute*; obtuse; reflex; right-angle, for example.* An opportunity to merge this knowledge with the topic of triangles. A combination of listening (the instructions); drawing or writing, guessing and then testing; and even conversing (within pairs) were relevant skills to this whole activity.

To begin this activity, the students were asked to name the different angles therefore introducing words like: tāhapa; hāpūpū; rāwaho; hāngai; rārangi; and porohita.

Words written on the blackboard were:

Hāpūpū hāngai rāwaho tāhapa rārangi porohita

The students then were asked to arrange the names of the angles (prior knowledge) in sequence from the smallest to the largest angle.

tāhapa hāngai hāpūpū rārangi rāwaho porohita

Although there were a few hesitant parts where the student was unsure of the correct sequence the activity continued until the end. *A lot of self corrections were made in this activity.*

The students were then given the opportunity to make any corrections to the sequenced words.

The follow-up of this was the description of the particular angles.
Tāhapa – kei waenganui i te kore me te iwa tekau. // Acute angle – between zero and ninety degrees. 0° < 90°
Hāngai – iwa tekau putu. // Right-angle – ninety degrees.
Hāpūpū – nui ake i te iwa tekau he iti iho i te kōtahi rau waru tekau. // Obtuse angle – greater than ninety degrees but less than one hundred and eighty. 90° < h < 180° (written on board.)
Rārangi – kotahi rau waru tekau putu. // Straight angle – one hundred and eighty degrees.
Rāwaho – nui ake i te kotahi rau waru tekau putu, iti iho i te rua rau whitu tekau putu. // Reflex angle – greater than one hundred and eighty degrees and less than two hundred and seventy degrees. 180° < r < 270°.

The interrupted section was to allow the students to reconstruct through explanation a rather exact equation describing the angles. For example; Mo te tahapa he pai kia timata ki te kore, ka mutu pu ki te 90°? For the acute angle, is it good to start at zero and end full stop at ninety degrees?
Kao! No!
No te mea he iwa tekau putu ko te hāngai…. Because a right angle triangle is the ninety degrees….. (The bell rang!!!)

The next section involved the students, in pairs, drawing triangles with a specific angle or specific angles. For example; tuhituhi i tētahi tapatoru e whakaatu ana i tētahi koki tāhapa. // draw a triangle that shows an acute angle.

Vocabulary:
koki - inside angles
rārangi – straight angle
porohita – full-turn
tāhapa – acute angle
hāpūpū – obtuse angle
rāwaho – reflex angle
hāngai – right angle

Outcome:
A compact 45 minutes that involved a lot. Drawing out good explanations from the students, letting them make corrections about this angle and that angle. The whole idea was simply to allow the students to talk about something they already had encountered. Hence the quickness of explanations about the angles. Working in pairs proved a good move to allow all students to become involved in the activity of drawing their own examples of certain triangles with the assistance of their peer if needed. The language was definitely used in this activity.

Class: Tau 7/8
Teacher: T1 Lesson: 2

Overall Objective: Using the appropriate mathematical equipment for constructing angles, and using this knowledge to create triangles.
Curriculum Strand: NZMC Level 4 Geometry
Topic: Triangles.

Resources:
ine koki
tātaitai

This particular activity involved: working in pairs; using the protractor; estimating angles and testing the estimated angles with the protractor.
The students were given a piece of paper alongside their usual materials of a pencil and a ruler and a protractor. Some students were chosen at times to demonstrate a particular activity on the whiteboard, therefore, a larger protractor was required.

First activity: One student was to draw a triangle with two acute angles using a ruler and pencil. Making an estimated guess of the angles, the students then wrote their estimations in the appropriate positions in the triangle. The second student then tested the angles with a protractor. This simply was to see how close or far the estimations were to the real measurements. A role reversal, but this time adding an obtuse angle or reflex angle.

Second activity:
Demonstrating at the whiteboard:

- one student to draw a triangle and then place estimated angles.
- three students tested the angles with the large protractor, which proved a little difficult for one student.

Eventually, an understanding of the three angles within a triangle adding up to 180 degrees. Again all the students were involved in constructing, estimating, and eventually calculating their angles to sum to 180°.

Vocabulary:
ine koki – protractor
tātaitai – calculator

Outcome:
In a time frame of 45 minutes, demonstrations on the whiteboard (more student involvement) and then student's attempts to write and check their work; I thought this was rather a good lead-into activity. Prior knowledge background at the beginning of this activity was essential and the activity rolled on quite smoothly. The students felt comfortable with this activity. A couple of students still needing attention in the use of a protractor. It was OK!!

Class: Tau 7/8
Teacher: T1 Lesson: 3

Overall Objective: Using the appropriate mathematical equipment for constructing angles, and using this knowledge to create triangles.
Curriculum Strand: NZMC Level 4 Geometry.
Topic: Triangles.

Aim: Distinguishing features of triangles.

This particular activity involved a discussion on the various triangles. The students were to name, if they could, the triangles and what differences if any there were. Many students could name correctly the triangles and give one difference which was to do with the sides.
He tapatoru taharite – e rite ngā taha katoa. (All the sides are the same.)
He tapatoru waerite – e rua ngā taha e rite. (Two sides the same – wae – meaning legs.)
He tapatoru rite kore – kare ngā taha e rite ana. (Not the same.)
He tapatoru hāngai – he rārangi e noho huapae ana me tētahi e pou tū ana. E 90 putu te koki. (One vertical and one horizontal line with a 90 degree angle.)

Probably this activity did introduce angles in each of the triangles and making similarities to the sides for assistance.
For example:

- Mehemea e rua ngā taha e rite ana, e rua ngā koki e rite ana hoki. (If two sides are equal then two angles must also be equal.

Using given angles as examples the students were able to calculate the missing angles by using the angles of a triangle rule.

Vocabulary:
tapatoru – triangle
tapatoru waerite – isosceles triangle
tapatoru hāngai – right-angled triangle
tapatoru taharite – equilateral triangle
tapatoru rite kore – scalene triangle
taha – side
koki – inside angle

Outcome:
This was a short period, and why a discussion on this topic was best. The children co-operated well. I used lots more movements with hands. Probably felt more expressive that morning. Because of the set up of the classroom (Art room), the students are seated in row behind row as the room is fairly lengthy. Maybe the reason for movements. Short but sweet.

Class: Tau 7/8
Teacher: T1 Lesson: 4

Overall Objective: Using the appropriate mathematical equipment for constructing angles, and using this knowledge to create triangles.
Curriculum Strand: NZMC Level 4 Geometry
Topic: Triangles.

Aim: Constructing triangular prisms with mathematical equipment.

Today's activity was a full-on discussion, concentrating on the students' prior knowledge of constructing triangles, and its connection to networks of 3D shapes, like the triangular prism, for example. This involved a fair bit of participation from the students and from what I could see they seemed to be able to bounce off one another for information and build on to this information. While again there were hesitant spots, the whole activity proceeded smoothly. I was facilitating in a way (either repeating words or sentences, or demonstrating by pointing etc.) to enable this activity to flow. A fifteen minute segment, followed by the students, constructing their own network using the equipment. (See yellow card for students attempts.) A language based activity.

Lesson: 5
Movie with two students from Tau 7.

To finish this unit of full-on discussion and written activities on 2-D and 3-D triangles, particularly the construction of triangles, the idea of this video was to allow two students to demonstrate their knowledge on video, was the ultimate objective. The students were to demonstrate to each other, through the language of instruction, their knowledge of constructing a triangular prism network. Each in turn talked through the steps of creating the network. They were both confident in talking about the equipment use, the placement of equipment, as well as in the actual drawings.

Overall comment on Tau 7/8.
I am absolutely pleased that this class (despite the noisy background at times) had all completed or met this objective. The students of Tau 7/8 have a very wide ability range, and although there was fine work done by the two students which is seen in the last movie, the samples show that all the students know how to construct correctly a network using the mathematical materials. Very fine samples. I could have chosen another couple of students in place of the two who were videoed, but clarity of language was needed. A great activity where te reo Māori (students) came to the forefront with minor mistakes, however. I enjoyed immensely this activity and believe the students did too.