What's For Lunch?
Lesson 3: Develop Phase

Australian Curriculum: Mathematics (Year 2)

ACMNA027: Recognise, model, represent and order numbers to at least 1000.

ACMNA028: Group, partition and rearrange collections up to 1000 in hundreds, tens and ones to facilitate more efficient counting.

ACMNA030: Solve simple addition and subtraction problems using a range of efficient mental and written strategies.

ACMNA031: Recognise and represent multiplication as repeated addition, groups and array.

Lesson abstract

Students implement a range of known and invented strategies to work out how many of their selected item they eat in a year. Through sharing, discussion and feedback, students refine the calculation process. They consider and develop more flexible and efficient counting, grouping and adding methods. They reach consensus about the most efficient strategies to use. Groups begin to use a grid paper representation, to explain their chosen strategy and mathematics used.

Mathematical purpose (for students)

Use your plan to calculate the approximate number of your food item your group eats in one year.

Mathematical purpose (for teachers)

Students calculate totals using their chosen mathematical strategy and explain their thinking using appropriate mathematical language. They represent their mathematics in various forms, and later use arrays on grid paper with annotations to explain the mathematics used. At the end of the Develop phase, groups will be able to:

- Calculate the total number of food items their group will eat in one year.
- Evaluate and improve the effectiveness of their strategies.
- Provide mathematical evidence to show their working and totals.
- Describe their methods and strategies using mathematical language.
- Create an annotated representation on grid paper which outlines their process.

Lesson Length 60 -90 mins, or split lesson into two halves

Vocabulary Encountered

- array
- skip count
- calculate/calculations

Lesson Materials

- student workbooks, tablets (optional)
- A3 paper (several sheets per group)
- 1cm grid paper (several sheets per group)
- scissors and glue
- coloured pencils
- Teacher Sheet 1 - Part A Work Samples and Teacher Sheet 2 – Part B Work Samples (optional)

We value your feedback after these lessons via https://www.surveymonkey.com/r/CV2TXTT

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Part A: Developing and Refining Strategies

The Develop phase contains two parts. Part A allows students time to develop their strategies through a series of iterations and sharing of ideas. Part B will be addressed by groups once they have completed their calculations and checked their responses. Part B provides opportunities for students to further consider the efficiency of strategies.

Developing strategies to calculate the number of [sandwiches]

1. Revisit the amended plans from the Devise stage and have groups explain any changes they made. If changes were not made, have students explain why no changes were made.

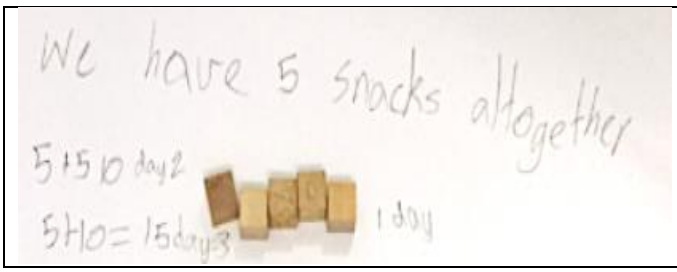
2. Have groups implement their plan. Students should be encouraged to use whatever physical materials or drawings they need to help. They should record all working in enough detail for someone else to understand their thinking.

3. Allow students time to apply their strategies, and encourage them to discuss their ideas. Move between groups to ensure they are recording all working clearly so it may be used as evidence to justify their responses during the Defend phase. Teacher Sheet 1 - Part A Work Samples shows some annotated work from students in trial schools.

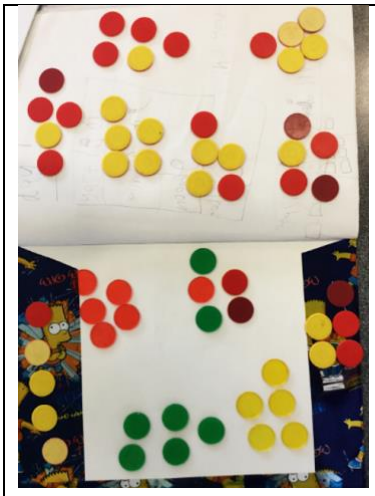
4. Look for opportunities to highlight the mathematical language recorded on the word wall (grouping, adding, repeated addition, skip counting and arrays.) Question students for understanding. If students encounter a problem, rather than offer direct suggestions, use prompting questions and listen carefully to their responses. For example:
    - *What are you trying to do? What have you tried? What else could you try? What help do you need to move forward? When you have found this number, what is your next step?*
    - *Show me how many [sandwiches] you eat on day 1 with blocks.*
    - *Is there a better way to make 15 instead of using 15 ones? (ANS: MAB – use tens and ones)*
    - *It is difficult for me to see that there are 25 in this bundle without counting them. How do you know there are 25? Do you need to count them every time? What could you do to help you remember how many there are or make it immediately obvious to me? (label with a number)*
    - *Is there a better way of drawing the pictures so they are easier to count? How have you drawn pictures before, so groups are easier to count? (arrays)*

Examples of students using concrete materials to represent their daily and weekly totals.

	Unifix cubes used to represent a daily total of 6 (black) and a weekly total of 30 (all).

	*MAB ones used to represent a daily total of 5. Annotated with words. Number sentence written for multi-day totals (unfinished).*

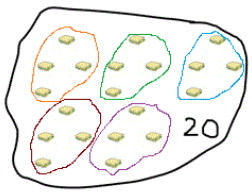
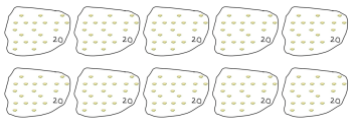
	A 100 board used to count in fours to reach a weekly total of 20 (unfinished).

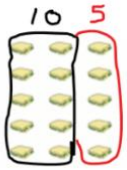
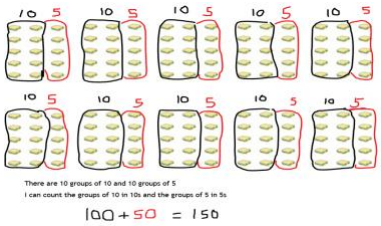
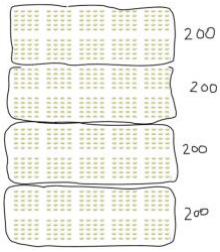
	This student was successfully continuing to make daily totals of 5. When questioned, he was unsure of his next step. Student: *I am making the number of fruit we had yesterday. I will keep making fives until I make the whole year.* Teacher: *How many will you need to make?* Student: *Probably lots. Probably too many counters. It will take too long. It took me ages to make 12 days.* Teacher: *I can see your Day 1 total is 5. Draw a circle around it so we can see it clearly and label it 'Day 1.'* *Your group had 5 pieces of fruit on Day 1 (indicate the group circled). Write down how many pieces of fruit would your group eat in 2 days. What about in one week which is 5 days?* And so on…

Checkpoint: Is it working?

5. Some groups may need suggestions from others to help them progress. Bring the class together for a Checkpoint. Have them explain their method again using the examples in their workbooks and highlight any problems they are having. It is important for all students to actively listen, so they may aid. Students also share their successes, especially if they may be of help to those experiencing difficulty.

   Possible issues and suggestions that may arise:

Issues	Suggestions
***There are too many sandwiches to draw* OR *We did not have enough counters*.** This highlights the need for mathematical thinking, as it is too labour intensive to represent large numbers with one-to-one concrete materials. It is also worth noting that sandwiches should be represented by simple marks, and not elaborately drawn. 	a) Take photos of a collection for a week and make ten repeats using a device to provide a concrete pictorial representation for the number of sandwiches eaten in a term.  b) Draw how many sandwiches eaten in a week (20). Write 20 for each week instead of drawing or copying sandwiches for each of the weeks of the term.

Some numbers are hard to add multiple times. This highlights the need for partitioning. 	Demonstrate this technique to the class, using the pictures or concrete materials provided by students. 
Some pictures are hard to count. This highlights the need to organise the collection into arrays and split the arrays into smaller collections to make addition of totals easier.	a) Encourage the use of arrays as on easier way to count weekly totals through repeated addition or skip counting. Look for arrays for students to share with the class as more efficient ways to group and count. b) Encourage the use of circling and annotating to simplify repeated addition to calculate totals. 

6. Allow groups time to use suggestions from the Checkpoint to continue refining their strategies as they work towards the total eaten in a year. Look for opportunities to discuss the efficiency of the strategies being used as students complete their calculations. Ensure they have the evidence necessary to demonstrate their strategy to the class during the Defend stage (next lesson). Students require clear representations and models.

Part B: Represent with Grid Paper

7. Because students will complete their calculations at different stages, the teacher introduces groups to Part B once they have an answer the inquiry question (e.g. we will eat approximately 120 pieces of fruit in a year) with sufficient supporting evidence. Many groups will begin this task in the next lesson.

8. Explain to students that to check and display their strategy and maybe make it more efficient, they can arrange strips of grid paper to represent the mathematics used to calculate their yearly total. These strips of grid paper will make arrays (one large array for the year, or smaller arrays for weeks, month and the year) and students will explain how the arrays match the totals in their calculations.

9. Possible responses are shown on Teacher Sheet 2 – Part B Work Samples. In Example B2 response, the student has chosen to represent daily, weekly, term and yearly totals.

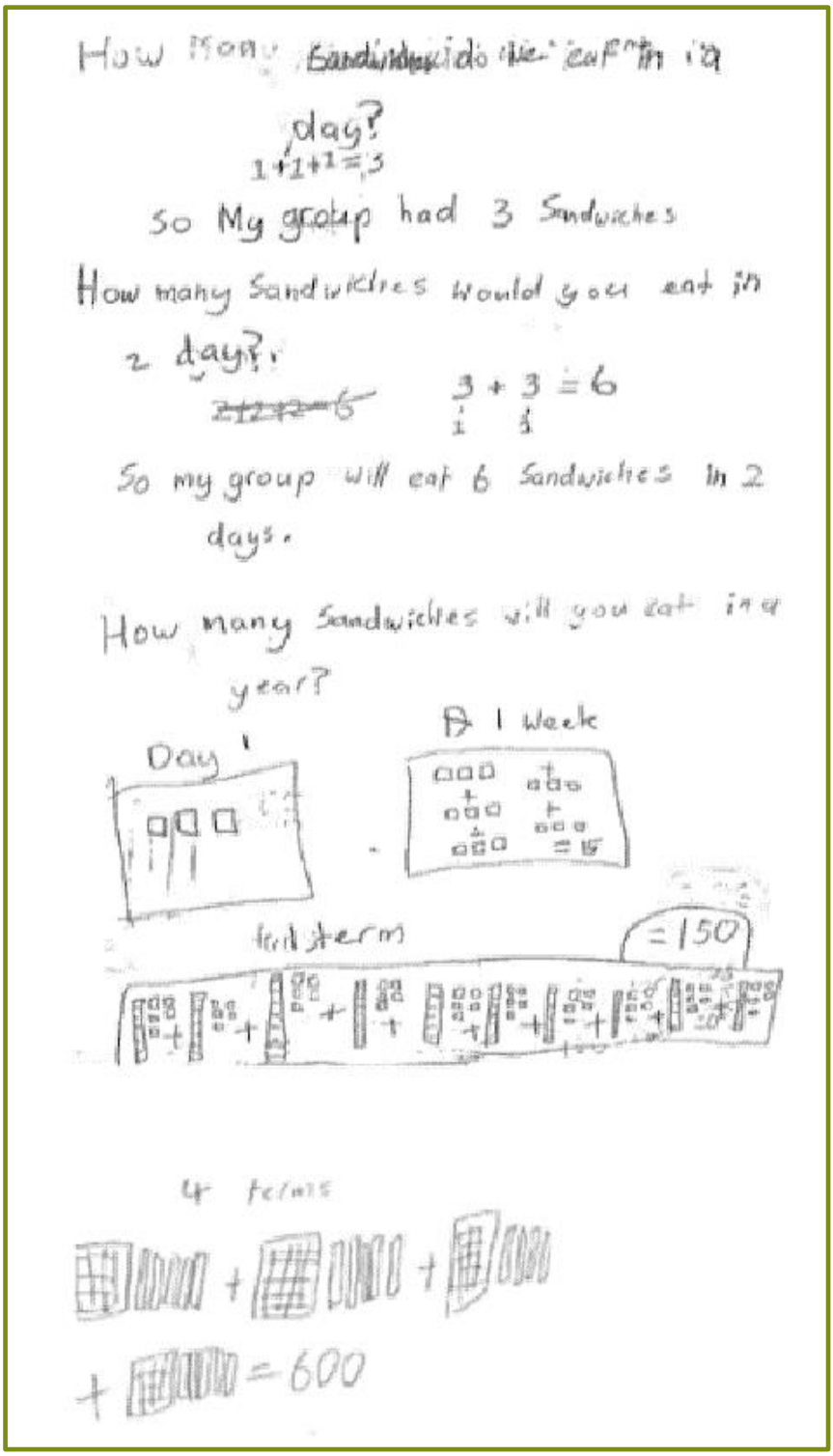
Conclusion

10. Before closing the lesson, have groups reflect on how the Checkpoint assisted them to work towards answering the inquiry question. Students will complete work on the grid representation and present their answers to the inquiry question in the next lesson.

Teacher Sheet 1 – Part A Work Samples

Example A1

This work sample provides a clear, well documented sequence of steps used to calculate approximately how many sandwiches will be eaten in a school year. Students represented their thinking with drawings of MAB. They counted in tens and then fives to find a term total of 150. They used MAB to represent 150, four times. They counted in hundreds and then tens to 100.



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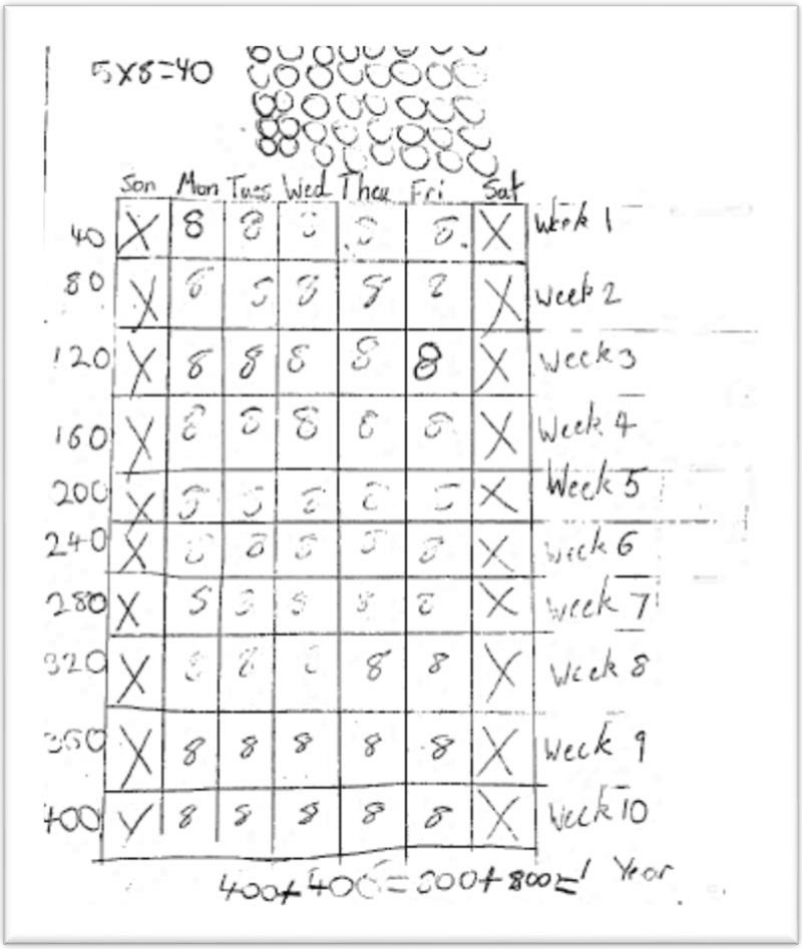
Example A2

This work sample shows drawing to find the Day 1 total of 8 and a weekly total of 40. The group has then created a table to represent the weeks in a term and repeated addition of 40 to find the total. Each student in the group created the same table and then compared their calculations. Their calculations were inconsistent resulting in different totals, requiring further calculations to reach a consensus.



This group was challenged by the task of trying to multiply 400 by 4.

Student 1: *4 x 4 = 16 so 400 x 4 =160*

Teacher: *Are you sure? Can you show me what that looks like? Look at your total for one term. Is 160 a reasonable answer for how many sandwiches you would eat in a year?*

Student 2: *No, of course not because it is the same as week 3 total. But I don't know what 400 x 4 is because I haven't learnt that one.*

Teacher: *If 400 x 4 is too difficult, how else could you find a total? You need to discuss this further and let me know what you come up with.*

Student 1: *We could try 400 + 400 + 400 + 400*

Student 3: *400 + 400 = 800, 800 + 800 = ? That's too hard.*

Student 2: *400 + 400 = 800. We could use our fingers to count in 100s to add the other 800.*

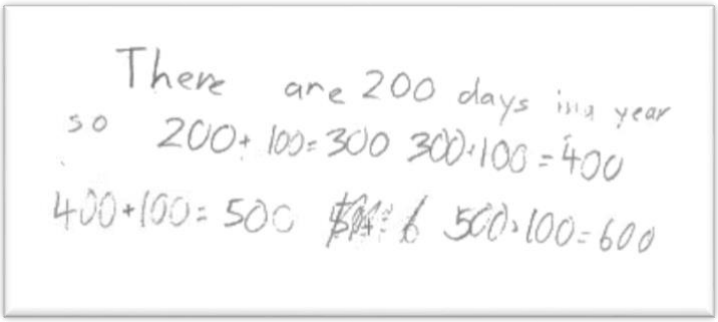
Student 3: *800, 900, 1000. What comes after 1000? Is it one thousand, one hundred; or eleven thousand or something?*

Student 1: *Write it down so we can look at it. It is one thousand and one hundred. Now it's easy to count because it just goes up in hundreds. Cool. We ate one thousand and six hundred pieces of fruit in one year.*

Teacher: *The correct way to say that is one thousand, one hundred. We leave out the 'and'.*

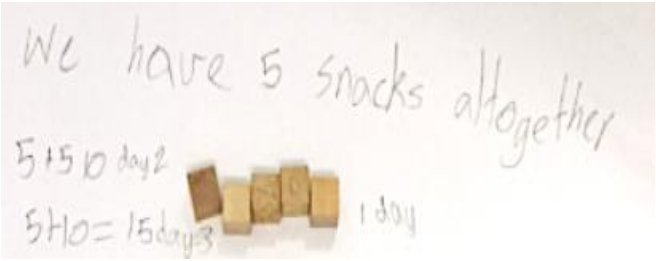
Example A3

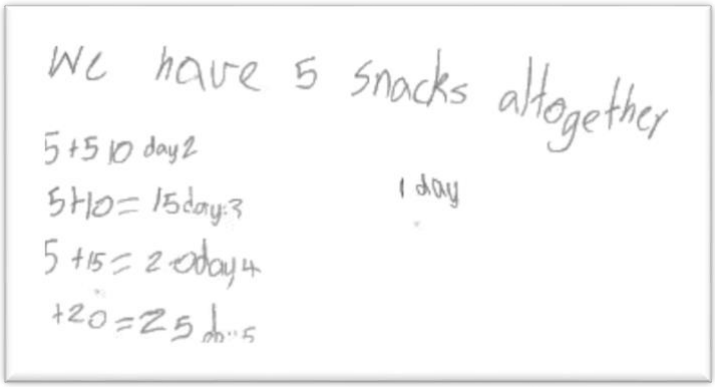
This work sample shows the group calculating how many days in a week, a term and a year. They have drawn 5 circles in a row to represent 5 days in a week, and then 10 rows. There is no reference to the sandwiches at this stage.

Teacher: What have you calculated? What does the 200 total represent? Student: There are 200 school days in one year. Teacher: Go back to our inquiry question. What are you trying to find? Student: How many sandwiches we eat in one year. We haven't got the sandwiches yet. Teacher: So what will you need to do next? Student: We need to find how many sandwiches we ate on those 200 days. We ate 3 each day. Teacher: Great. I'll come back to see how you worked it out.	
	Teacher: Can you explain why you have added all these hundreds? Student: We had 3 sandwiches every day so I had to have 200 groups of 3. That's the same as 3 groups of 200. I broke the 200s into 100s, so it was easy to add. We ate 600 sandwiches in one year. Now I think I could just add 200+200+200 and get 600. It's like counting in twenties but it's hundreds.

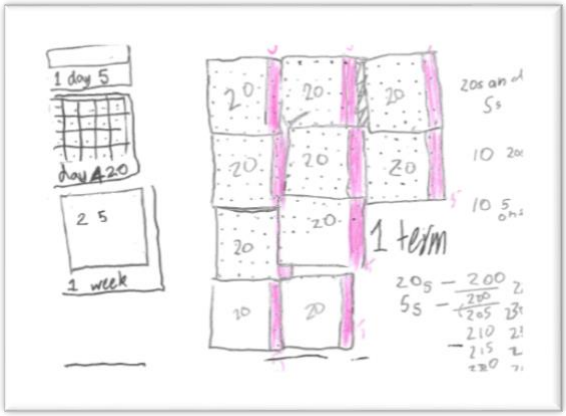
Example A4

This work sample shows repeated addition, starting with a day 1 number of 5.
Student counted 5 blocks repeatedly.





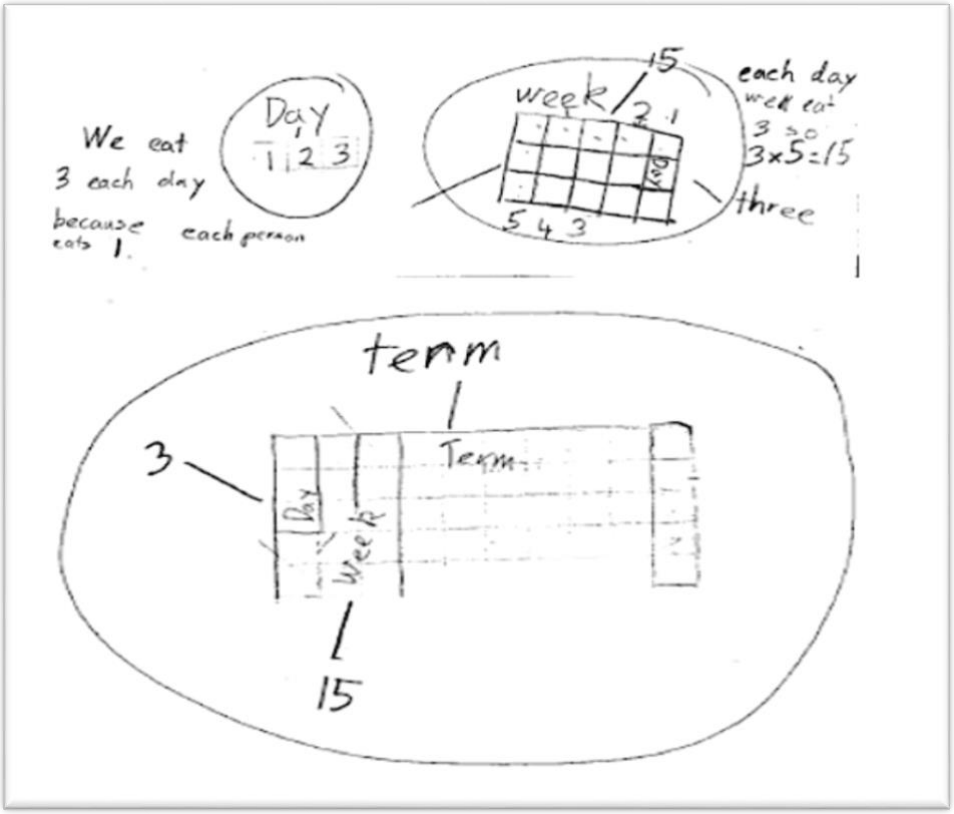
Example A5: Partitioning 25 into 20 + 5

 Grid lines were not visible.	This student copied the number sentences and calculations from someone else and could not explain her work. She used MAB to create her weekly total. She then started to create a term total by repeating her 25 MAB in the same format. Teacher: Is there a better way to make 25 with MAB? Student: I could use 2 tens and 5 ones. She could then explain her strategy to the group.

Teacher Sheet 2 – Part B Work Samples

The following examples are incomplete and are presented again in the Defend phase lesson plan to show how feedback has provided students with prompts to further explain and effectively annotate their representations.

Example B1



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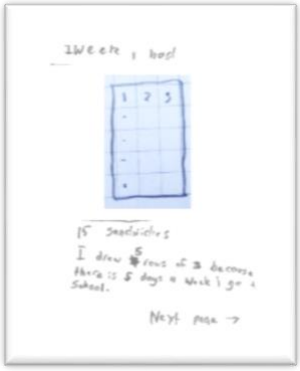
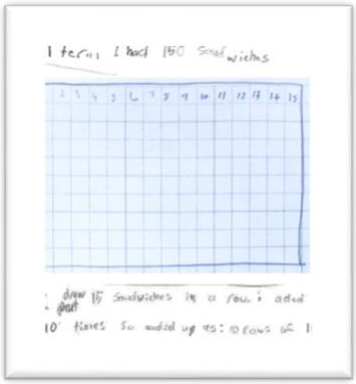
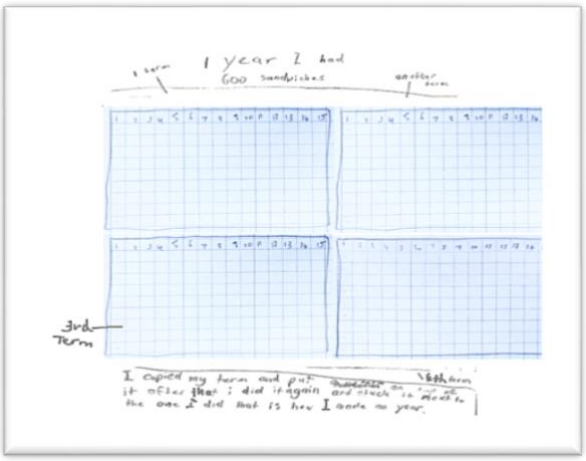
Example B2

	Day 1 total (3) is represented with a strip of grid paper and annotated with words and numerals.
	*Weekly total represented as an array on grid paper. Representation is annotated, and array partially justified. No evidence of number sentences.*
	*Term total represented as an array on grid paper. Representation is annotated, and array partially justified.*
	*Yearly total represented as an array on grid paper. Representation is annotated, and array partially justified. No computational evidence of how the total was calculated.*