Sample experimental problems:

Foundation experimental problem: teacher notes

Student: Riley

Diagnostic tasks:

- I placed 6 counters in a cup and shook it, asking "How many would there be?"
  Riley had no difficulty with this, no matter how many times the counters were shaken, moved, swapped or changed colours. She was able to conserve number consistently.
- I placed counters into a cup, took some out, added more in and then shook them.
  Riley had no difficulty following the changes and working out exactly how many counters there would be, even with two and three step changes. (9 of the 13 children got stuck with this task).

Problem Solving task:

Riley was placed in the extension group for a partitioning activity. She was given 8 blocks to place into two bowls. Riley came up with all the different combinations very quickly (8 and 0, 7 and 1, 6 and 2, 5 and 3, 4 and 4) and was very sure that she had identified them all. She did not double up on any combination and understood the commutative property (5 + 3 is the same as 3 + 5) of turn-arounds.

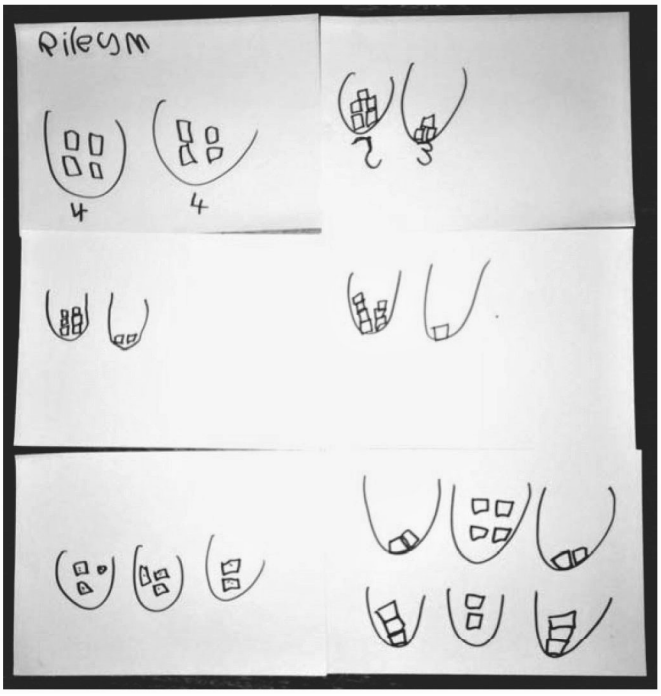
Riley was then challenged to work out what was missing: I hid some blocks and gave her the remaining blocks. Riley had no difficulty working out missing add-ends.

Riley was then further challenged as follows:

Now imagine that there are three bowls to separate the blocks into instead of two bowls. One of the bowls holds 2 blocks. If the other two have the same amount as each other, how many would there be in each?

Riley initially answered "two" using mental images, but then drew the blocks and self-corrected to three with no prompting.

She also decided to try one for herself, and came up with 4, 2 and 2.

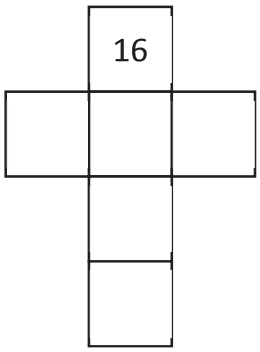


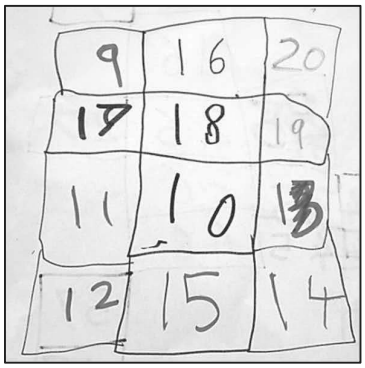
NB: For attendees of the professional development course on Assessment and Moderation in Primary Mathematics, a video sample of Riley completing this task is included in the online resources.

Year 2 experimental problem: teacher notes

Brittney can count fluently past 100, including counting forwards and backwards in 1s, 2s, 5s and 10s. She can count in 10s from any number.

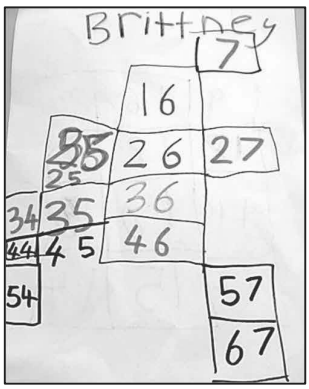
Brittney examined a hundreds chart with other students in her grade. She easily stated the counting patterns horizontally and vertically. Her fluency levels were well up to this task, but the question below clearly involved a lot of new thinking for her as evidenced by her responses:

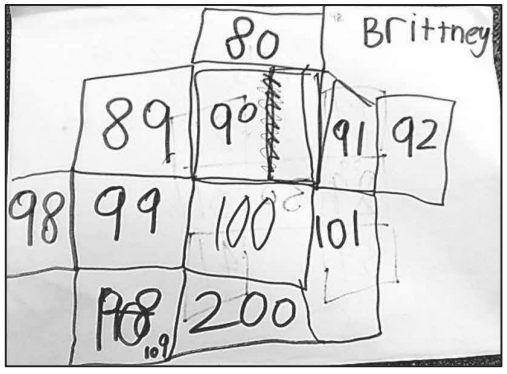




After this initial response, the teacher circled the number underneath the 16 and asked to have a look at that space on the hundreds chart. Brittney stated that it was 26. I then asked how 16 and 26 were "kind of the same", and what the difference between them was. Brittney could identify that they both ended in 6, but not that the difference between them was 10. Brittney was asked to make 16 from base 10 blocks then add extra blocks to turn it into 26. She counted on until she reached 26, then identified that it was 10 blocks that she had added. She then arranged the 10 blocks into a straight line to resemble a "10" block.

Brittney was then asked to predict what number would be underneath the 26. She replied 27. The process was repeated, with "how are 16, 26 and 36 kind of the same?" and "how are the numbers changing?" The picture below shows Brittney's second response. The second picture shows her extension question. While these clearly show the growth in her understanding of the underlying patterns and principles a new misconception is obvious in the third picture.

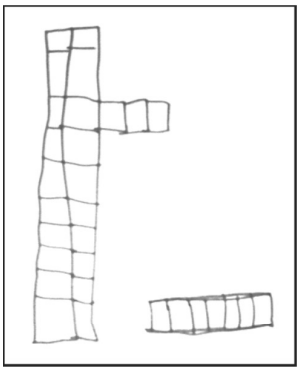




Year 5 experimental problem: teacher notes

Task description

Students were asked to make 23.7 using base 10 blocks, then to consider how many different ways there would be to make 23.7 if they had "tenth" blocks.



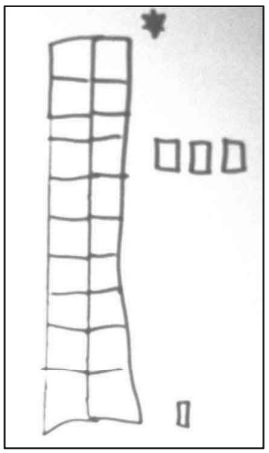
Student: Ethan

Ethan initially used 2 tens blocks, 3 ones blocks then left a space and added another 7 ones blocks to represent 7 tenths (see picture on the right)

Ethan was asked confronting questions such as:

- If we push all of the blocks back together, do we still have 23.7?
- If there are 30 blocks when it is pushed together, can it still be 23.7 when it is separated?
- Is 23 bigger or smaller than 23.7? Is 24 bigger or smaller than 23.7? So, what does that tell us?

From these questions, Ethan decided that his initial attempt would make 30 blocks, not 23.7.



Ethan's second attempt (photograph on the right) shows the growth in his thinking. He now uses part of one block to represent the 7 tenths. However, the part of the block was described by him as "about a half". He did not divide one block into ten pieces and use seven of them. He also did not use a ruler to mark 0.7mm on the 1cm block.

After this, the following questions focusing on the base-ten system as were used:

- How many ones are in one ten block? (Ethan answered 10)
- How many tens are in one hundred block? (Ethan answered 10)
- How many hundreds are in one thousand block? (Ethan answered 10)

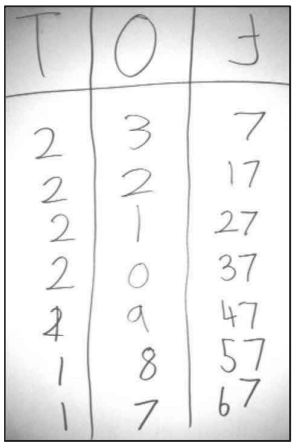
And of course the reverse:

- How would we cut a thousand block to make a hundred block? (Ethan answered cut in 10)
- How would we cut a hundred block to make a ten block ? (Ethan answered cut in 10)
- How would we cut a ten block to make a one block? (Ethan answered cut in 10)
- So... how would we make the part after the decimal point using the one block?

Following these questions, Ethan decided to cut the one block into 10 pieces and use 7 of those pieces to represent the 0.7. Ethan called the pieces "tenths".

Ethan's extension task:

Ethan was posed a new problem: If you actually had these little tenths pieces, how many different ways could you make 23.7 using tens, ones and tenths blocks?



Once he had worked out the base ten pattern from the initial problem, Ethan had no difficulties extending the pattern to find variations for how to make 23.7.

He also showed a self-correction.

He was easily able to explain the pattern that he used, and demonstrated adding each number together to prove that it was 23.7: "1 ten is 10, then add on 8 ones makes 18. Then we have 57 tenths, which is the same as 5.7. So that makes 23.7."