Bags of flour

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First Steps in Mathematics project

The following is an activity which has been used by the team working on the *First Steps in Mathematics* project in Western Australia.

The task

Each day in a bakery, three eighths of a bag of flour is used for bread and a quarter of a bag is used for cakes.

Is more flour used for bread or is more used for cakes?

Please use a diagram to explain your thinking.

The *First Steps* researchers gave this task to children in Years 5, 6 and 7, interviewing each of them individually. You might like to try the activity out with your students before you explore their results.

Are the responses what you expected? What do they tell us about what the students know about fractions? What else do they need to know?

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This task was developed by Wendy Devlin and Gail McLay as part of the *First Steps in Mathematics* research, based on an article by K. Hart et al. (1989, *Children's Mathematical Frameworks 8-13: A study of classroom teaching*, p. 69). Work samples published here were collected by Kaye Treacy, Glenys Reid and Sandra Murray. Information was compiled by Kaye Treacy, who developed the section of the *First Steps in Mathematics* professional development upon which this section of the Virtual Conference is based.

A classification scheme for responses to the 'Bags of Flour' task

Kaye Treacy and her colleagues presented the "Bags of Flour" task to fifty three children in years five, six and seven. Interviews with the children were taped and transcribed, and their oral responses were sorted according to commonalities in what they were thinking.

Group 1: Children choose bread because eight is bigger than four and three is bigger than one. These children are simply comparing the numbers as though they were whole numbers.

Group 2: Children choose cakes because quarters are bigger than eighths. These children have started to learn about fractions, but ignore the numerator.

Group 3: Children choose bread because three eighths is bigger than one quarter; e.g., I know two eighths is the same size as one quarter, or three eighths is the same as one and a half quarters.

They found the following distribution of responses:

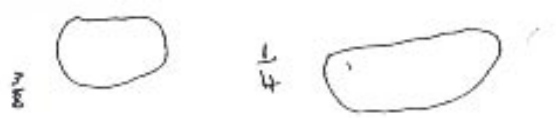
	Year 5 (20)	Year 6 (12)	Year 7 (21)
Group 1	11	5	4
Group 2	4	4	9
Group 3	5	3	8

Children in groups one and three all choose the correct answer, however, children in group one are getting the correct answer with absolutely no fraction understanding whatsoever. This shows that children can get the right answer with little or no understanding. Kaye reports that they have found this often in their research.

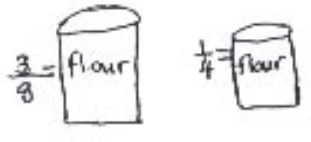
Looking in detail at the students' diagrams also provided a wealth of information about children's fraction understandings (and misunderstandings).

Student work sample A

Child 1 Year 5

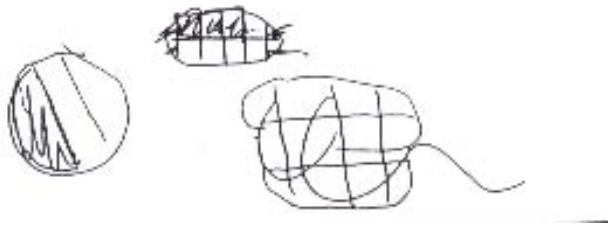


Child 2 Year 7



Child 3 Year 5

Child 4 Year 7



The work samples here show little or no understanding of the partitioning required to construct a diagram of a fraction.

Child 1 drew 'blobs' of flour for each.

Child 2 drew bags of flour.

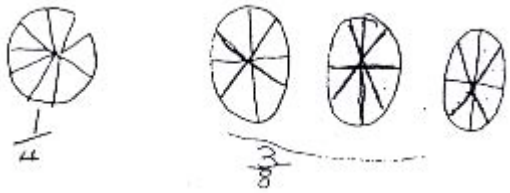
Child 3 was able to show $\frac{1}{4}$ but did not partition the squares into eighths to show $\frac{3}{8}$.

Child 4 cut the circle into three and coloured one for $\frac{1}{4}$ and had difficulty dividing the other two shapes into eighths. Note also that two different shapes were used for the two different fractions.

These children all said that $\frac{3}{8}$ is bigger because 'eight is bigger than four and three is bigger than one'. They think of fractions as two whole numbers.

Student work sample B

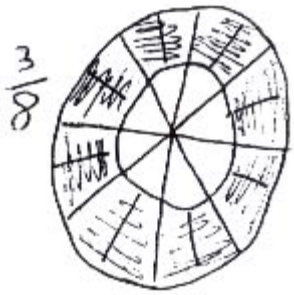
Child 1 Year 5



Child 2 Year 5

Child 3 Year 7

Child 4 Year 5



The work samples here show that the children know that fractions have something to do with the numbers one and four, and three and eight, but do not understand the part whole nature of fractions. These children all said that $\frac{3}{8}$ is bigger because 'eight is bigger than four and three is bigger than one'. They think of fractions as two whole numbers.

Child 1 for $\frac{3}{8}$ drew three circles each partitioned into eighths, but for $\frac{1}{4}$ did not cut the circle into four.

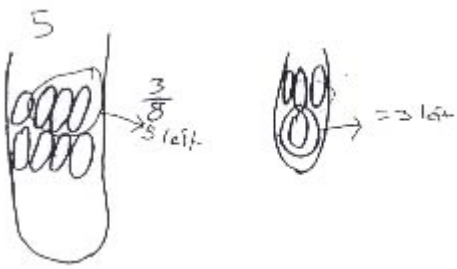
Child 2 drew three bags of flour on top of eight bags of flour for $\frac{3}{8}$ and one bag of flour on top of four bags of flour for $\frac{1}{4}$.

Child 3 drew three circles each with eight lines in them and one circle with four lines in it.

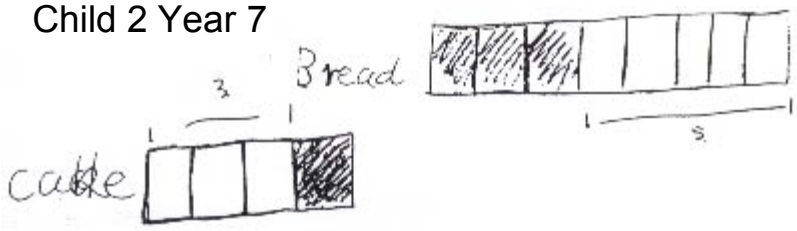
Child 4 drew a circle, partitioned it into eight sections and then partitioned each of these into three sections. When asked to 'show me the three eighths' the child pointed to the middle circle.

Student work sample C

Child 1 Year 5



Child 2 Year 7

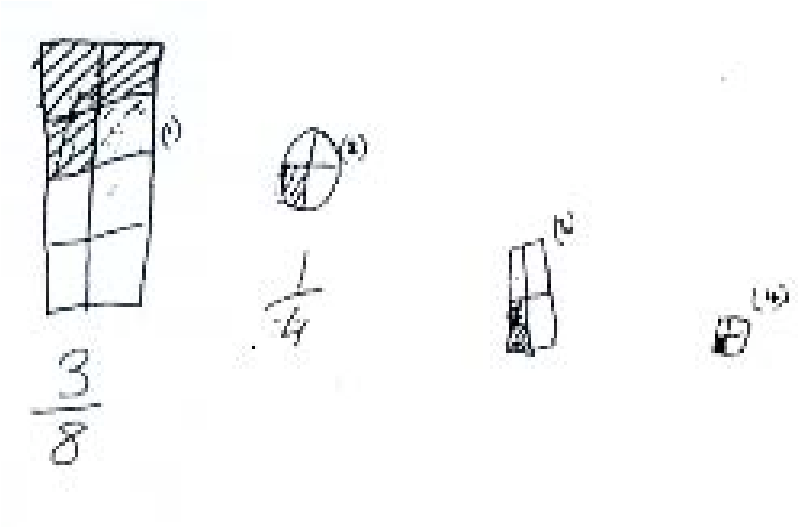


Children here compare the size of the fractions by thinking about the difference between the two numbers in the fraction. These children are still thinking of fractions as two whole numbers.

Child 1 drew bags of flour, one with eight little bags inside it the other with four. He circled the three bags for $\frac{3}{8}$ but explained that $\frac{3}{8}$ was bigger because there was five little bags left over as compared to three left over for $\frac{1}{4}$.

Child 2 was similar to the child above except that the diagram was a more conventional rectangle. Note also, the size of the diagrams, the $\frac{1}{4}$ diagram is much smaller than the $\frac{3}{8}$ diagram.

Student work sample D



The transcript of the interview for this child shows she was thinking that a fraction was limited to a particular shape. She thought that a quarter could only be drawn using a circle. After drawing diagrams 1 and 2 the interviewer asked, 'Why did you use a circle not a rectangle?' (for the diagram of a quarter).

The child replied, 'Because it's better if you do a circle because a quarter of a circle is a quarter.'

Interviewer: 'Could you do it with a rectangle?'

The child drew rectangle 3 and said, 'No, you can't because it's more than a quarter because of the extra bit when compared with the circle. It would be bigger, one sixth maybe.' The child was imagining the circle superimposed on the rectangle and seeing the part of the rectangle that would be exposed under the circle. She then spontaneously drew a smaller circle, 4, and said, 'It's smaller: must be both the same.'

Interviewer: 'Are you saying this, (rectangle) is a quarter then?'

Child: 'Yes.'

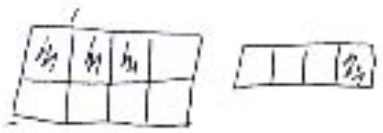
Interviewer: 'What made you change your mind?'

Child: 'Looking at that it can be any size to make a quarter.'

Note: the questions used here helped the child to construct a better understanding of fractions.

Student work sample E

Child 1 Year 5



Child 2 Year 5

Child 3 Year 7

These work samples show that the children are able to partition shapes to construct a representation of the given fractions. However, these children drew a different sized shape for the different sized fractions. They all drew the shape for $\frac{1}{4}$ smaller than the shape for $\frac{3}{8}$.

Child 1 used this diagram to show that $\frac{1}{4}$ is bigger than $\frac{3}{8}$ saying that, '[be]cause if you cut one thing into 8 and the other into 4 pieces the 4 pieces would be bigger'.

Child 2 used this diagram to show the same as child one and then as he was talking through it changed his mind to say that $\frac{3}{8}$ was bigger 'because it's equal to one and a half quarters'.

Child 3 used this diagram to say $\frac{3}{8}$ was bigger because 'both the numbers are higher'.