ILLUSTRATING THE MATHEMATICS STANDARDS

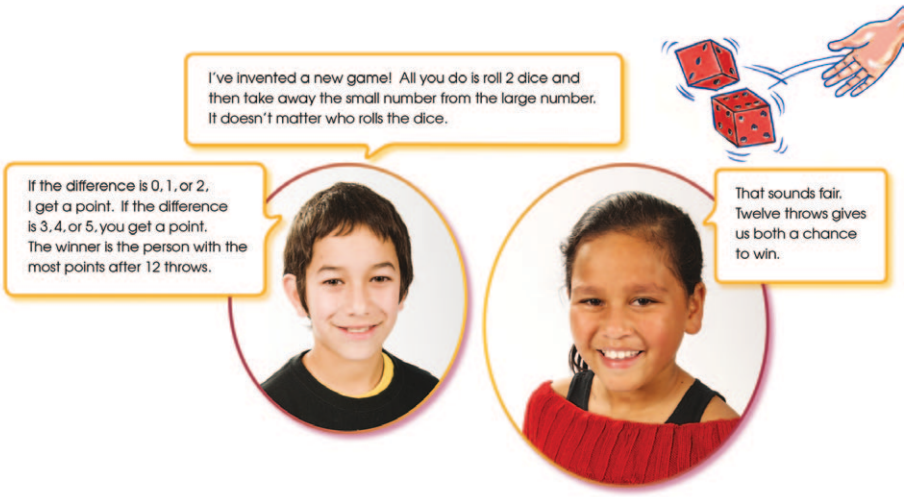
The following examples of student work illustrate achievement at the mathematics standards for years 5, 6, and 8.

Dicey Differences

The task used in this illustration was adapted from an activity in Figure It Out, *Statistics (Revised Edition)*, Level 3. The teacher gave the task to her year 5–7 students after a discussion about the "fairness" of games that they were designing for the school gala.

The task relates to achievement objectives for Number and Statistics from the mathematics and statistics learning area in *The New Zealand Curriculum*.

Dicey Differences



1. *Before you play, write down whether you think the game is fair or not and give your reasons.*
2. *In pairs, take turns to throw two dice and record the difference. Use your data set to investigate outcomes that are possible and whether the game is fair.*

Some features of students' work used to make judgments in relation to the mathematics standards are described below.

Dicey Differences

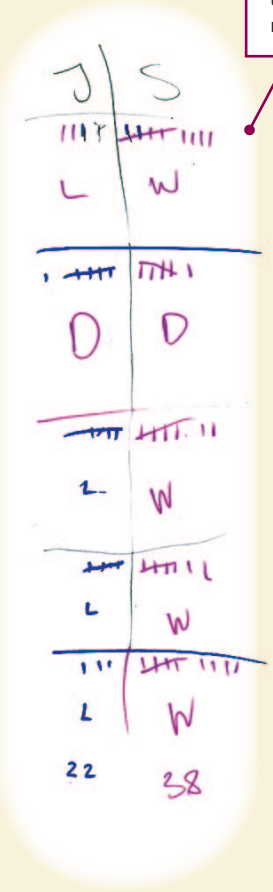
New Zealand Curriculum: Level 3	*Mathematics Standard: By end of year 5*
In solving problems and modelling situations, students will:	
Number and Algebra • *use … additive and simple multiplicative strategies with whole numbers, fractions … and percentages (number strategies)*	*Number and Algebra* • *apply additive and simple multiplicative strategies … to:* – *combine or partition whole numbers* – *find fractions of … quantities*
Statistics • *investigate simple situations that involve elements of chance …, acknowledging that samples vary (probability)*	*Statistics* • *order the likelihoods of outcomes for simple situations involving chance, experimenting or listing all possible outcomes*

I think it is unfair because it is more likely to get 0,1,2. Because to win you would have to get 4,5,6 and 1,2,3 on the dices.

Stacey discussed why she thought the game was unfair and justified her response with a comment on possible outcomes.

OK, I know that to get 3, 4, and 5, I need to always have one large number on one dice and 1, 2, or 3 on the other. Once we start playing the game, I'll see what the chances are for that to actually happen.

Stacey recognised the need for many dice throws so that she could use her experimental results as a reasonable estimate of probability.



Stacey put her experimental results for 60 dice throws into a table.
She used halving to work out what percentage 38 is of 60.

J	S
22	38

30 = 50%.
15 = 25%.
7½ = 12½%.

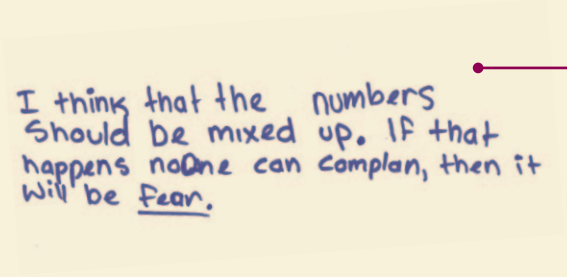
22 + 38 = 60. 30 is 50 percent of 60. So 15 is 25 percent and $7\frac{1}{2}$ is $12\frac{1}{2}$ percent. 30 and $7\frac{1}{2}$ is nearly 38. So that's 50% + $12\frac{1}{2}$% = 62.5%. The person getting points from 0, 1, and 2 has about a 62 percent chance of winning.

Discussion

This task provides some of the evidence needed to show that Stacey is achieving at early curriculum level 3 and the year 5 standard in Number and in Statistics. She is able to estimate likelihoods by experimenting. She is also able to apply a simple multiplicative strategy (partitioning in halves) to her experimental results, which indicates that she is beginning to work at the Advanced Additive stage of the Number Framework.

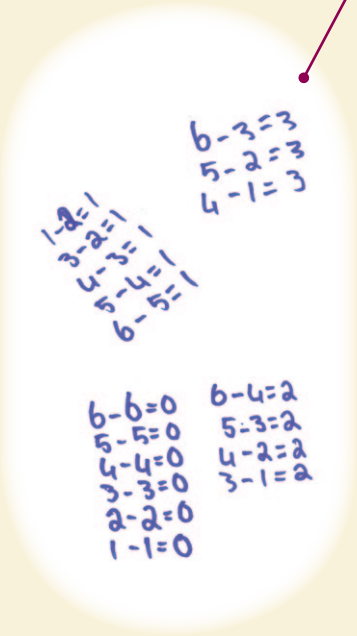
Dicey Differences

New Zealand Curriculum: Level 3	*Mathematics Standard: By end of year 6*
In solving problems and modelling situations, students will:	
Statistics • *investigate simple situations that involve elements of chance by comparing experimental results with expectations from models of all the outcomes, acknowledging that samples vary (probability)*	*Statistics* • *order the likelihoods of outcomes for situations involving chance, considering experimental results and models of all possible outcomes*



Quinn implied that he thought the game was unfair by immediately suggesting a change to the rules (sharing out 0–5 rather than 0, 1, 2 and 3, 4, 5) to make it fair.

Quinn started by recording points for him and his partner but, after a few trials, he focused on recording possible outcomes.



Hey, these numbers are in some kind of pattern! There's six 0s, five 1s, four 2s ...

When Quinn noticed a pattern forming, he swapped to a table.

−	1	2	3	4	5	6
1	0	1	2	3	4	5
2	1	0	1	2	3	4
3	2	1	0	1	2	3
4	3	2	1	0	1	2
5	4	3	2	1	0	1
6	5	4	3	2	1	0

The table shows that there is a pattern. I was right: the player with 0, 1, and 2 is much more likely to win than the other player.

Brandon will win because he will get more points.

Quinn could see from his table that the player with 0, 1, 2 was more likely to win.

Discussion

This task provides some of the evidence needed to show that Quinn is achieving at curriculum level 3 and the year 6 standard in Statistics. Although Quinn doesn't follow through on the task and compile a full set of experimental results, he demonstrates his ability to move logically through his investigation. He discards his trials when it becomes obvious that one player is winning more often. When he sees a pattern in possible outcomes, he moves to a table format that models all outcomes. He uses the information to draw a conclusion and justify his opinion.

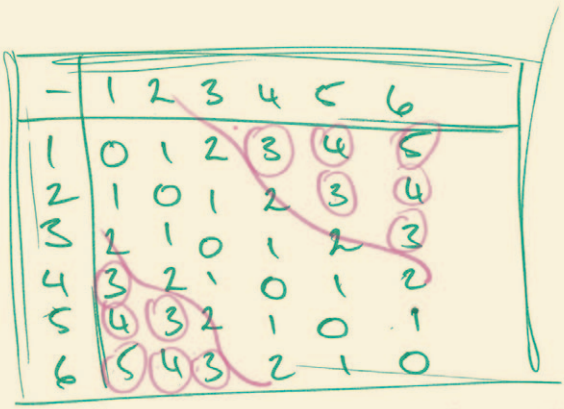
ILLUSTRATING THE MATHEMATICS STANDARD

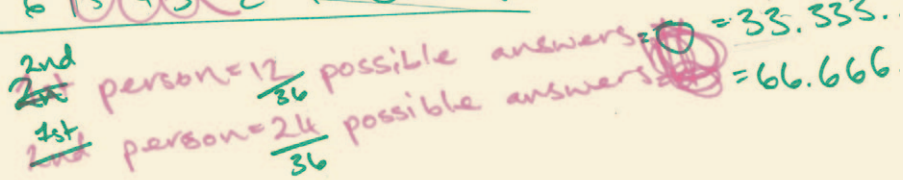
Dicey Differences

New Zealand Curriculum: Level 4	*Mathematics Standard: By end of year 8*
In solving problems and modelling situations, students will:	
Statistics • *use simple fractions and percentages to describe probabilities (probability)*	*Statistics* • *express as fractions the likelihoods of outcomes for situations involving chance, checking for consistency between experimental results and models of all possible outcomes*

The teacher observed that Jared read the instructions and then predicted that the differences of 0, 1, and 2 would have more possible combinations than the differences of 3, 4, and 5. He decided to work on his own to test his prediction.

Jared chose not to play the game to get experimental results. Instead, he checked his prediction by developing a grid to model all possible outcomes. He used simple fractions and percentages to calculate the likelihoods of 0, 1, 2 and 3, 4, 5.





Even though I know that the likelihood of getting a difference of 0, 1, or 2 is higher than for 3, 4, and 5, player 2 could still win, depending on what numbers come out on the dice. But if you keep playing and record lots of results, you would start to see the 33 and 66 percent pattern.

Jared acknowledged that chance could affect the outcome of a game but used his understanding of all possible outcomes to discuss why, with a larger trial sample, the likely outcome can be predicted.

Discussion

This task provides some of the evidence needed to show that Jared is achieving at curriculum level 4 and the year 8 standard in Statistics. Although he doesn't compile a data set of experimental results, he models all the possible outcomes for the game in a table and applies proportional thinking to find fractions and percentages for the likelihoods of winning and losing.