

Mathematics in the New Zealand Curriculum Second Tier

Strand: Statistical Thinking

Thread: Statistical Investigations

Level: One

Achievement Objectives: Conduct investigations using the statistical enquiry cycle by:

- Posing and answering questions by collecting;
- Gathering, sorting and counting, and displaying category data;
- Discussing the results.

Exemplars of student performance:

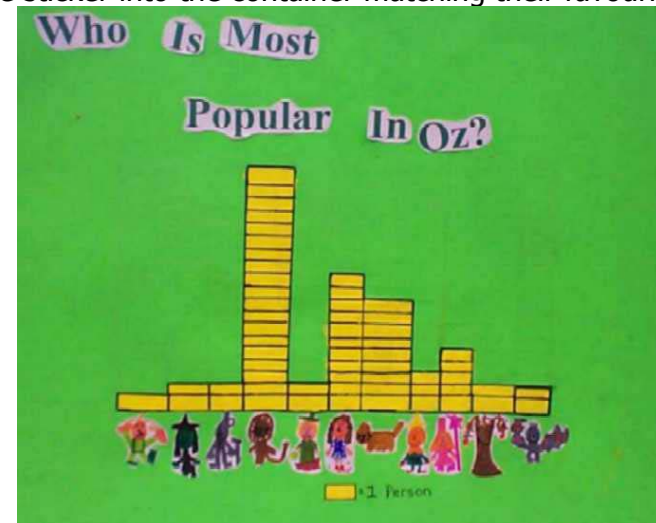
Exemplar One: The teacher reads "The Wizard of Oz" to the students. Students decide on their favourite character and explain their choice. They wonder, "Which character in the story is the most popular?" The teacher puts the students into pairs and allocates characters from the story for them to draw. Paper clips are used to fasten the pictures to individual icecream containers. Each container is labeled with the character's name.

Each student receives a narrow *post-it*™ sticker. They vote for by putting the sticker into the container matching their favourite character. The class collates the results on a bar graph to show the results.

Characher from the Wizard of Oz
Munchkins
Dorothy
Wizard
Scarecrow
Lion
Witch form the east
Witch from the west

The students discuss the results with reference to the graph. They form conclusions that can be substantiated by counting and comparing the data, such as:

"The Lion is the most popular because he gets 19 votes. Dorothy only gets 11 votes. That is 8 votes less."



This exemplifies Level One because the students are investigating a question using category data (favourite character). The students are sorting the data into categories and constructing an appropriate data display (block graph).

Exemplar Two: What shall we sell as our fundraiser?

The school is to sell a selection of novelty bars from the office as a fundraiser. The children brainstorm a selection of their favorite novelty bars. The teacher creates a data card (see below) to record individual choices based on the bars suggested by the students. He/she duplicates the cards so every student in the class (other classes, teachers, parents) can tick their favourite bar on an individual card. These cards are duplicated so each group of students gets a set.

The students sort the data cards by the selected responses. They collate the data by grouping the cards in bars. By drawing around the silhouette of the cards they display their results on the footpath for all to see. Use of different colours to distinguish between the bars and labeling of the axes and title are features of the data display.

Favourite Novelty Bars	✓?
Butter fingers	
Kit kat	
PayDay	
Snickers	
Moro	
Picnic	
Flake	
Hershey	



The students make statements that are supported by the data, such as:

"I was surprised that only five people like Paydays because I think they are really nice. 12 people like Butter Fingers which is funny because I don't like them so much."

This exemplifies Level One because the students are investigating a question using category data (favourite novelty bar). The students are sorting the data into categories and constructing an appropriate data display (bar graph).

Exemplar Three: Happy Hats

During the summer the students bring along their favourite hat. The class brainstorms questions about the hats, such as:

What is the favourite colour for hats in this class?

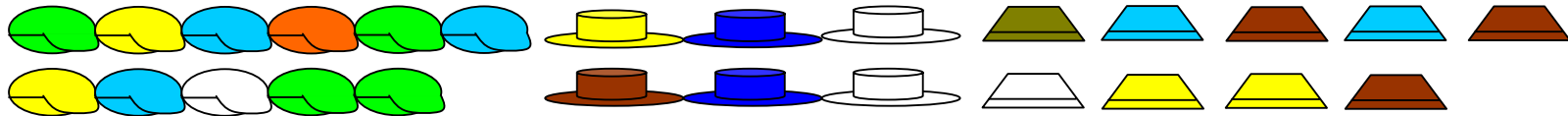
What types of hat do people in our class wear?

What materials are our hats made from?

How big are the hats?

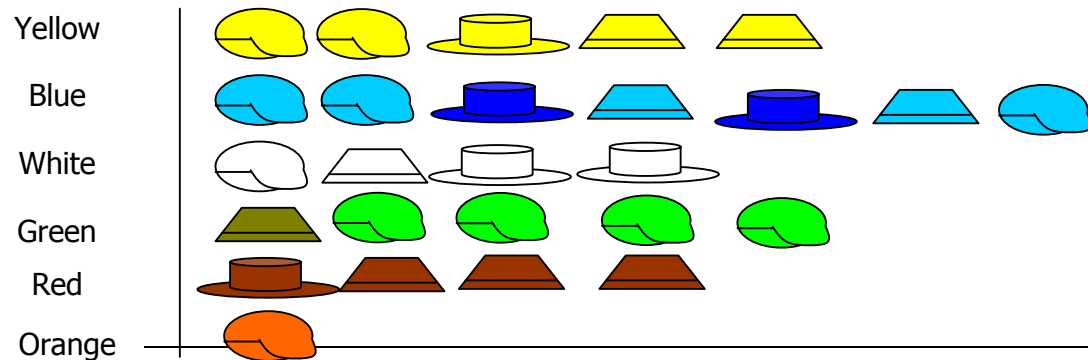
The students sort and resort the hats to answer these questions. They create informal category displays to present the data.

For example, they create a sets display for hat type:



They notice by counting that caps are the most popular and wonder why there are no beanies. They wonder if the favourite hats would be different in winter.

The hats are resorted to look for favourite colour and presented as a pictogram.



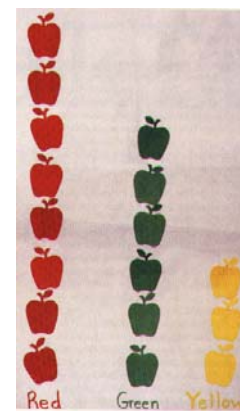
The students notice that blue is the most popular but many other colours like yellow, white, green and brown are almost as popular. They wonder if bright colours are more popular in summer and if the colours would be different in winter.

This exemplifies Level One because the students are investigating questions about their hats by sorting and resorting the data into categories. They are constructing appropriate data displays such as set displays and pictographs.

Exemplar Four: What is the colour of the apple you have in your lunchbox today?

Each student in the class brings an apple to school on Monday.
The teacher gives them a square of paper on which to draw their apple.
The squares are sorted by colour and used to create a pictograph to illustrate the data.

Students make comparison statements by counting the number of apples of each colour.
For example, "There are two more red apples than green apples,"
or, "There are half as many yellow apples as green apples."

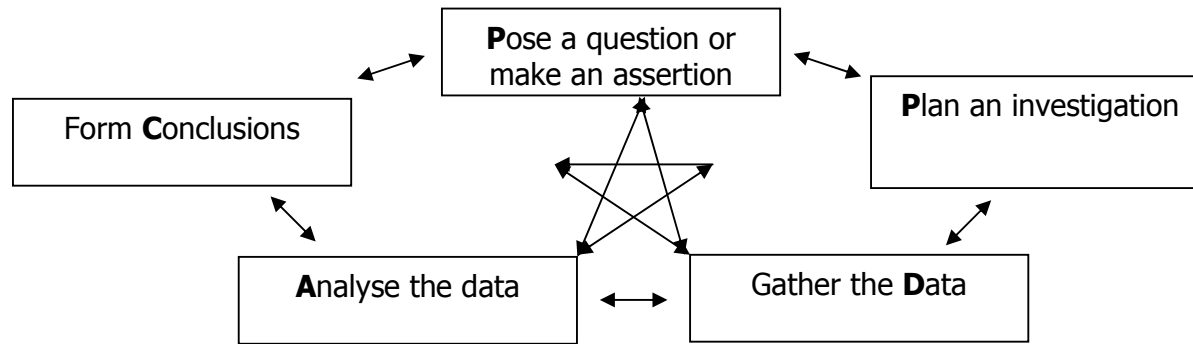


This exemplifies Level One because the students sort the apples into categories by the attribute of colour. They construct an appropriate data display (pictograph) using the objects.

Important teaching ideas (working at):















Students at level one are learning to investigate questions that involve grouping data into categories (category data). For example, pets grouped into cats, dogs, birds, fish, etc., or sports grouped into netball, soccer, rugby, cricket, etc. Students learn to classify objects and ideas through sorting and resorting. For example, students sorting toys might sort them by type (teddy, doll, car, etc.), by colour, size, shape. In this way the students identify attributes of the objects which is a critical part of the measurement process.

At this level it is expected that students will require considerable support in the statistical enquiry cycle. All parts of the cycle need modeling by the teacher with a view to students operating more independently. The cycle is as follows:



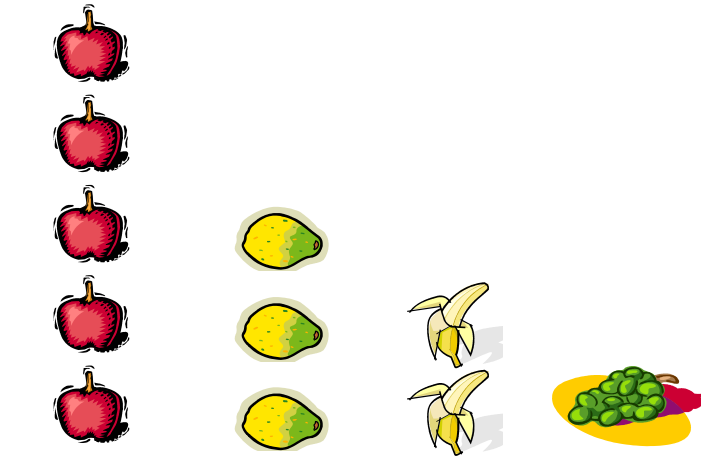
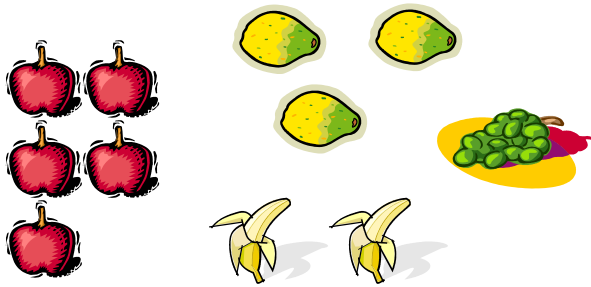
Important learning experiences are:

- Beginning with contexts that are part of the students' worlds encourage the students to pose questions and assertions. Assertions are statements that need verification, e.g. "Banana is the favourite fruit of people in our class," or, "Boys eat more sandwiches than girls."
- Discuss what data is needed to answer the questions and assertions, who might be asked, what they will be asked, or what objects are to be collected. Model efficient ways to gather the data, particularly considering the need for sorting and resorting. For example, simple iconic data cards can be completed by each student:

Name:						
Are you a boy or a girl?	<div style="display: flex; justify-content: space-around; align-items: center;">   </div> <div style="display: flex; justify-content: space-around; align-items: center;"> Boy Girl </div>					
How old are you?	5 years	6 years	7 years	8 years		
How do you get to school?	 bus	 car	 train	 plane	 bike	 walk
What is your favourite fruit?	 apple	 lemon	 grapes	 peach	 banana	 orange

• Create displays using the objects themselves or representations of the objects like drawings, cubes, or stickers. These displays are easier for the students to interpret as the individual data items (data points) are clearly visible. Students at level one will want to locate “their” response in any display. Encourage students to create their own data displays but connect the need for easy counting to the features of those displays.

For example:

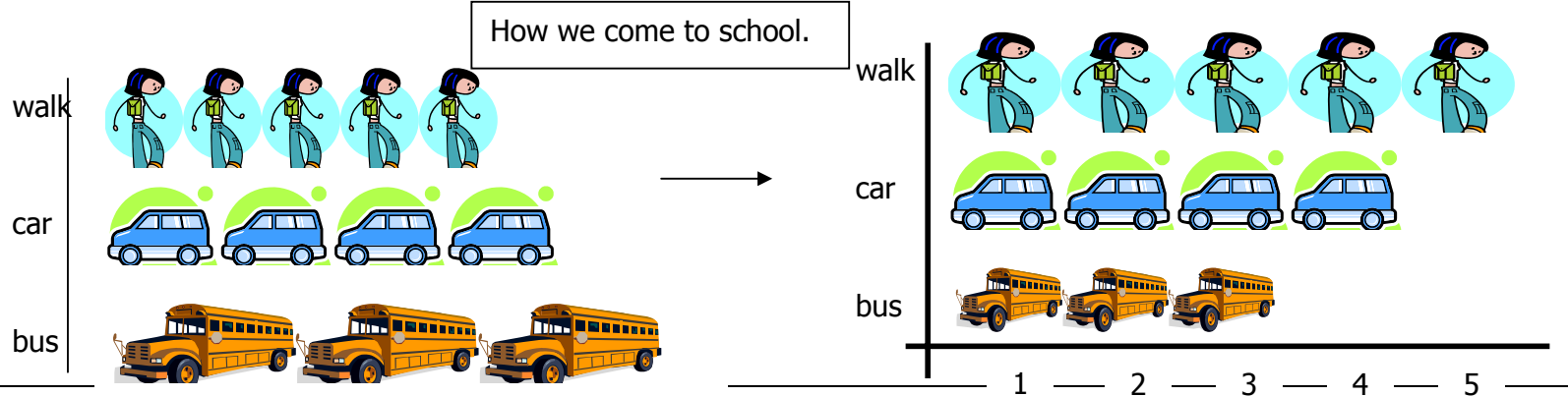


Patterned sets display...

leading to...

pictograph

To aid interpretation of data displays it is conventional to order the categories by frequency as shown above. Frequency is the number of data items in a category, e.g. There are 3 lemons. Use of objects to form the displays can raise other issues around counting and scale. Creating potentially distorted graphs can prompt students to consider these ideas. In the displays below inequality of the objects provokes the concept of a count as a measure and the need for scale.



- A key focus of the analysis part of the statistical enquiry cycle is on comparison. Statisticians are primarily interested in differences rather than similarities. For students at level one this involves comparing the counts for the various categories in a data display. Comparison presents a context for developing students' understanding of number. Concepts of "more than", "less than", and "same" (equality) need to be quantified, e.g. "How many more people like apples than bananas?" Note that students at level one are learning to count on and back with a direction to Part-whole (early additive) thinking.
Expose students to the fundamental conventions for data display, e.g. Labeling of the axes and a title, units of scale being the same. These conventions need to be justified by referring to audience interpretation. Sharing each others' displays can help students to recognize the need for these conventions.
- Students at level one should be able to make statements that answer an initial question or assertion. The statements should relate to the data displays they create, e.g. "There are four more girls than boys in our class." In appropriate situations ask causality questions, e.g. "Why are our hats mostly coloured blue, yellow and green?" Encourage students to pose further "I wonder" questions, e.g. "I wonder if older students in our school would come the same way?"

Useful resources

For two statistics units at level one refer to the nzmaths website using these links:

<http://www.nzmaths.co.nz/node/149> (Statistical Investigations: I like Trucks)

<http://www.nzmaths.co.nz/node/150> (Statistical Investigations: Greedy Cats)