Teaching Notes for Dragon Card Lesson Plan: Numerical Data Curriculum Level 3

Statistics Learning Centre

Overview

Achievement Objectives

S3-1: Conduct investigations using the statistical enquiry cycle: gathering, sorting, and displaying multivariate category and whole-number data … to answer questions; identifying patterns and trends in context, within and between data sets; communicating findings, using data displays.

Purpose

Investigating multivariate data using a set of dragon cards. Each dragon card provides several pieces of information about one dragon. Sorting and organising a set of dragon cards makes it possible to uncover information about the set.

Specific Learning Outcomes

- Sort information into categories.
- Display data in an appropriate format.
- Answer questions by sorting, organizing and arranging information.
- Make sensible statements about the information with supporting evidence.

Outline

Part 1 – Understanding the dataset

- Getting to know the dragon cards [Full class, 10 min]

Part 2 – Numerical data

- Vaccination dosage story [Full class, 5 min]
- Posing questions - [Groups, 10 min]
- Exploring and comparing - [Groups, 15 min]
- Results and conclusions - [Groups, 10 min]
- Further investigation - [Groups, remaining time]
- Finish up - [Full class, 5 min]

Equipment

- Pack of dragon cards (allow 240 cards for a group of up 32 students)
- Paper for students to record their results

Key Vocabulary

Categorical data, dataset, evidence, multi-dimensional, multivariate data, numerical data, statistical enquiry cycle, tends to.

Teacher Notes

Timings are approximate. Groups are likely to work through the phases at their own pace.

The statistics strand of the New Zealand mathematics curriculum is made up of three threads: Statistical Investigation, Statistical Literacy and Probability at all curriculum levels. This lesson is a part of the Statistical Investigation thread. The Statistical Enquiry Cycle underlies that thread.

The Statistical Enquiry Cycle is also called the PPDAC cycle. The steps in the PPDAC cycle are: Problem, Plan, Data, Analysis and Conclusion.

Part 1 - Understanding the data set

Getting to know the dragon cards [Full class, 10 min]

The third phase of the Statistical Enquiry Cycle is "Data". When an existing data set (in this case, the group's set of dragon cards) is being used, the investigator needs to become familiar with the data, to understand what it represents, includes and what the limitations of the data are. This understanding of the data set is used to inform the initial Problem and Plan phases of the Statistical Enquiry Cycle.

As well as being able to decode all of the information on the Dragon Cards, students should start becoming familiar with the symbols and categories.

The activity in this part of the lesson also models a possible analysis method. This can help to scaffold the analysis in the later part of the lesson.

Another option here is to get the students to try to find another student (or students) with four things or more on their cards that match. When they find a match they should hold up their hands with fingers showing how many things match.

Part 2 - Numerical data

Vaccination dosage story [Full class, 5 min]

A statistical investigation is more than just the analysis. It is important to have a context, which will give the investigation its purpose. This will inform the statistical questions to ask, the appropriate analyses and give meaning to the conclusions. In a statistical investigation (or lesson) it should be easy to answer the "why are we doing this" questions.

The story is intended to provide context and purpose. It is an important part of the lesson.

Posing questions - [Full class, 5 min]

The question should allow the students to use the dragon cards they have to help Dr Agon in the story. That is, it should link the story to the analysis. It is fine for different groups to have different questions. It can be useful to have the students write down their question that ensures it is more focussed than, for example, "We want to know about heights."

Some example questions are:
Do the heights of our green dragons tend to be taller than the heights of our red dragons?
Do the heights of our female dragons tend to be taller than the heights of our male dragons?
Do the heights of our dragons tend to be similar?

If students are not sure of the types of questions to ask, give an example and let students choose to use that example or come up with their own.

Best practice for investigative questions is to structure the question to allow the analysis of the investigation to be self-evident. For the first example question above, the key element, height, is at the very front of the question. The two populations to compare are clear: the heights of our green dragons and the heights of our red dragons. The comparison "tend to be taller" suggests the heights of most green dragons are expected to be bigger than the heights of most red dragons but with some red dragons possibly taller than some green dragons. At this level the questions are focussed on the group's set of dragons by use of "our".

It is useful for the teacher to model this best practice but, at this stage, it is fine for students to pose less clear questions e.g., "Are the red dragons taller?" It is also fine for students to refine, adapt or change their questions during the analysis.

Exploring and comparing - [Groups, 20 min]

Let students organise the data in ways that make sense to them. This lets them discover a good way to organise the data or see the advantages of a physical bar graph when they see it.

Randomly allocated cards can lead to quite different results from different groups, e.g., one group may have very few red dragons. Depending on your students and your confidence you might find it useful to 'stack' the decks prior to class, so that each group gets similar results, so that certain groups get similar numbers of red and green dragons, or so that you know the expected results. It is important that all groups do **not** get the same result.

Results and conclusions - [Groups, 10 min]

While recording results is important, do not worry about recording the graphs produced. Re-drawing the physical graphs is a useful way of recording results but not a good use of the student's time. You might, however, choose to take photos of the student's work.

The main focus for this part of the lesson should be on developing and recording sentences drawing conclusions.

Don't expect students to be able to use the framework given without being taught how to use it. Use it to encourage students to improve their sentences to the next level. For example, you might ask: "What evidence do you have that your red dragons are taller than your green dragons?" or, "What does that mean for the vaccination dosages? Should the team take larger or smaller dosages for the red dragons compared to the green?"

Students can be eager to get onto another investigation of the dragon cards. Before allowing that, make sure that they have recorded a concluding statement. Preferably the concluding statement should be meaningful to the context, that is, advice about the vaccinations.

Since the groups will generally have different results, minor counting or sorting errors can be ignored. Of course accuracy is important, however, the focus of this lesson is on the statistical investigation not counting and sorting.

Further investigation - [Groups, any remaining time]

This allows students who finish their investigation faster to practice the Problem, Analysis and Conclusions phases. Students can be eager to get to the analysis phase so, where appropriate, get them to pose, and possibly write down, their question first.

The questions should be driven by the previous investigation. That doesn't mean the questions need to directly address the vaccination dosage scenario. The question could, instead, arise directly from exploring the cards.

Some possible numerical questions:

Questions directly relevant to the vaccination dosage scenario:

- Do the heights of our female dragons tend to be taller than the heights of our male dragons?
- Do the heights of our female green dragons tend to be taller than the heights of our female red dragons, the heights of our male green dragons and the heights of our male red dragons?
- Do the heights of our dangerous dragons tend to be taller than the heights of our unpredictable dragons, and the heights of our friendly dragons?

Other questions:

- Does the strength of our green dragons tend to be larger than the strength of our red dragons?
- Does the age of our green dragons tend to be larger than the age of our red dragons?
- Do the heights of our dragons tend to get larger as the dragons get older?

Age is a continuous variable better suited to display as a histogram than a bar chart. Histograms bring their own set of challenges, for example, how big to make the bin sizes. Students may wish to wrestle with this challenge if they are ready for it.

Comparing two numerical variables can be done with a physical scatterplot. Here students lay out one variable in horizontally in proportion to its value, as in a bar chart. The other variable is

simultaneously laid out in a similar manner but vertically. In both directions spaces are left for missing values. Students may wish to wrestle with this challenge if they are ready for it.

Finish up - [Full class, 5 min]

Note the concepts of sampling from a population and inference to the population are at level 5 in the NZ Curriculum. At level 3 we are concerned with descriptive statistics, but students may gain an idea that different samples will give slightly different results. This will help for when the concepts of sampling and inference are introduced.

Further activities and resources are provided on http://shop.StatsLC.com
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